Fraser Earthmoving Construction Pty Ltd

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Part 6
Air Quality Impact Assessment

for the

Howlong Sand and Gravel Expansion Project

State Significant Development 17_8804

Prepared by

Todoroski Air Sciences Pty Ltd

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AIR QUALITY IMPACT ASSESSMENT

HOWLONG SAND QUARRY EXPANSION

RW Corkery & Co

2 March 2020

Job Number 18030807A

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Air Quality Impact Assessment
Howlong Sand Quarry Expansion

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1 INTRODUCTION

Todoroski Air Sciences has prepared this report for RW Corkery & Co on behalf of Fraser Earthmoving Construction (hereafter referred to as the Applicant). The report presents an assessment of potential air quality impacts associated with the proposed expansion of a sand and gravel quarry located to the southeast of Howlong in New South Wales (NSW) (hereafter referred to as the "project").

To assess the potential air quality impacts associated with the proposed project, this report incorporates the following aspects:

- A background and description of the project;
- A review of the existing meteorological and air quality environment surrounding the project site;
- A description of the dispersion modelling approach used to assess potential air quality impacts; and,
- Presentation of the predicted results and a discussion of the potential air quality impacts.

2 PROJECT BACKGROUND

2.1 Project setting

The project is located at 4343 Riverina Highway Howlong, approximately 2.5 kilometres (km) southeast of Howlong. The local land use surrounding the site is comprised of grazing and cropping with bushland around the river flats.

Figure 2-1 presents the location of the project and nearby sensitive receptors considered in this study. It should be noted that receptor R4 is located within the project boundary and is associated with the project, however it has been assessed as a sensitive receptor. The nearest receptor not associated with the project is located approximately 1.25km to the northwest. Other identified sensitive receptor locations are situated further afield to the northeast and east of the site.

Figure 2-2 presents a pseudo three-dimensional visualisation of the topography in the general vicinity of the project. The project area can be characterised as relatively flat overall along with the area following the river flat. The topography slopes towards higher elevations to the south-east and the north-east of the site.

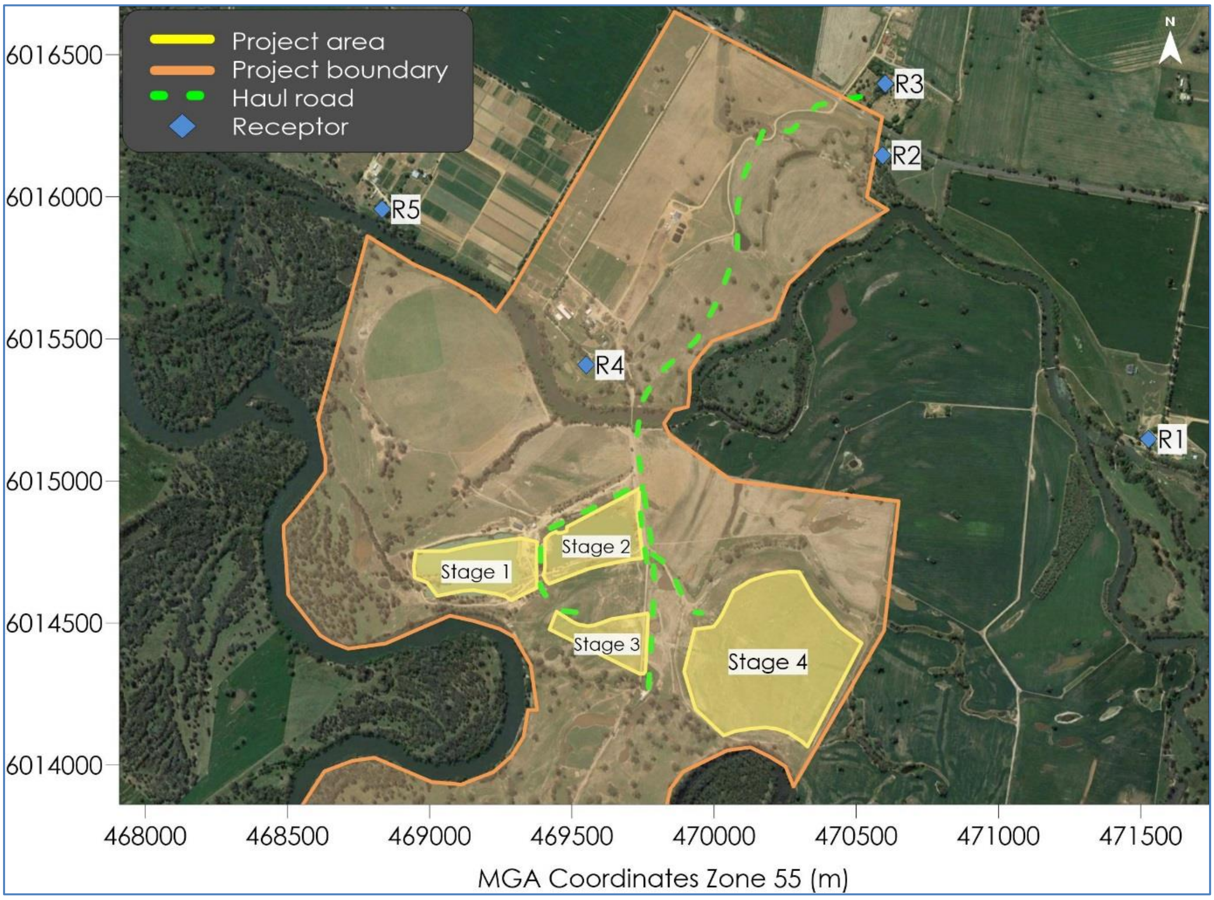

Figure 2-1: Project site overview

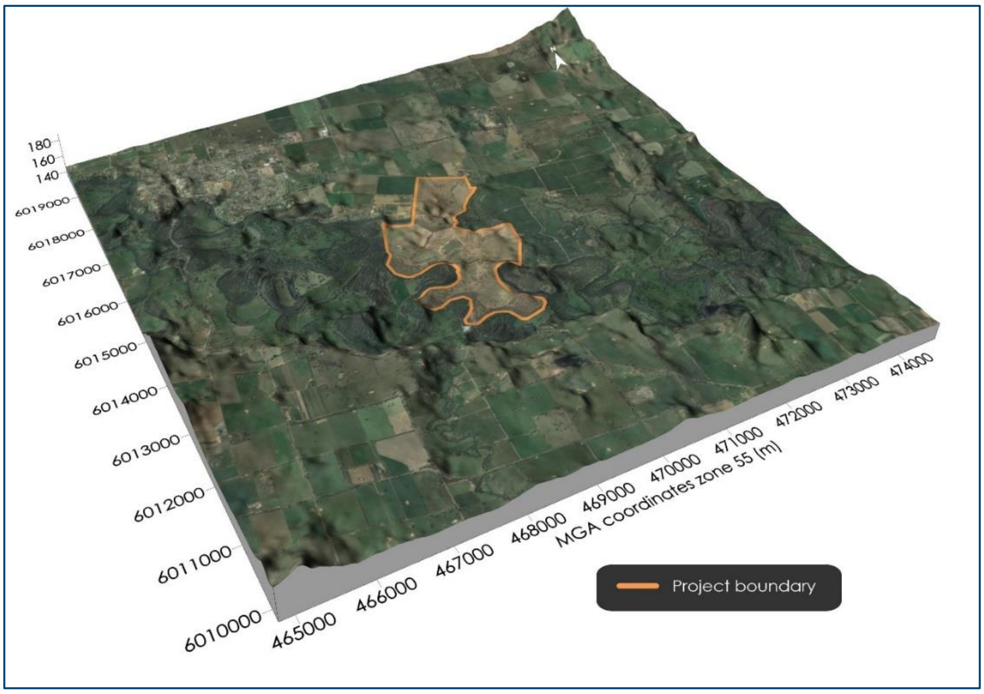

Figure 2-2: Representative visualisation of topography in the area surrounding the project

2.2 Project description

The existing sand and gravel quarry at the site has operated for 50 years and currently has approval to extract up to 30,000 tonnes per annum (tpa).

The Applicant anticipates that the proposed extraction operation would continue to utilise the existing plant, with equipment occasionally upgraded or replaced. The proposed expansion will set the annual maximum extraction limit at 330,000tpa with an assumed 10% loss of material through the washing process to result in 300,000tpa despatched from the Quarry each year.

It is estimated that the sand and gravel quarry would be able to access a total resource of approximately 8.9 million tonnes.

The project will include the following works:

- Extraction of sand and gravel to a depth of approximately 21 metres (to an elevation of 119m AHD) across the site at a rate up to 330,000 tpa;
- Screening and washing of raw materials as well as use of a mobile crushing plant approximately 4 times per year;
- Rehabilitation planting in completed sections of the extraction area, on the constructed levee banks and riparian areas outside of operational areas; and,
- Use of a dedicated, unsealed haul road and concrete bridge over the Black Swan Anabranch.

3 AIR QUALITY CRITERIA

3.1 Particulate matter

Particulate matter consists of dust particles of varying size and composition. Air quality goals refer to measures of the total mass of all particles suspended in air defined as the Total Suspended Particulate matter (TSP). The upper size range for TSP is nominally taken to be 30 micrometres (µm) as in practice particles larger than 30 to 50µm will settle out of the atmosphere too quickly to be regarded as air pollutants.

Two sub-classes of TSP are also included in the air quality goals, namely PM_{10}, particulate matter with equivalent aerodynamic diameters of 10µm or less, and $PM_{2.5}$, particulate matter with equivalent aerodynamic diameters of 2.5µm or less.

Particulate matter, typically in the upper size range, that settles from the atmosphere and deposits on surfaces is characterised as deposited dust. The deposition of dust on surfaces may be considered a nuisance and can adversely affect the amenity of an area by soiling property in the vicinity.

3.1.1 NSW EPA impact assessment criteria

Table 3-1 summarises the air quality goals that are relevant to this assessment as outlined in the NSW EPA document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA, 2017**).

The air quality goals for total impact relate to the total dust burden in the air and not just the dust from the project. Consideration of background dust levels needs to be made when using these goals to assess potential impacts.

Table 3-1: NSW EPA air quality impact assessment criteria

Pollutant	Averaging Period	Impact	Criterion
TSP	Annual	Total	90µg/m³
PM_{10}	Annual	Total	25µg/m³
	24 hour	Total	50µg/m³
$PM_{2.5}$	Annual	Total	8µg/m³
	24 hour	Total	25µg/m³
Deposited dust	Annual	Incremental	2g/m²/month
		Total	4g/m²/month

Source: NSW EPA, 2017
µg/m³ = micrograms per cubic metre
g/m²/month = grams per square metre per month

4 EXISTING ENVIRONMENT

This section describes the existing environment including the climate and ambient air quality in the area surrounding the project.

4.1 Local climatic conditions

Long-term climatic data from the closest Bureau of Meteorology (BoM) weather station at Rutherglen Research (Site No. 082039) were analysed to characterise the local climate in the proximity of the project. The Rutherglen Research weather station is located approximately 17.4km southwest of the project.

Table 4-1 and **Figure 4-1** present a summary of data from the Rutherglen Research weather station collected over a 28 to 105 year period for the various meteorological parameters.

The data indicate that January is the hottest month with a mean maximum temperature of 31.4 degrees Celsius (°C) and July is the coldest month with a mean minimum temperature of 2.1°C.

Rainfall is higher during the colder months of the year and declines during the warmer months, with an annual average rainfall of 586.9 millimetres (mm) over 76.7 days. The data indicate that July is the wettest month with an average rainfall of 61.7mm over 9.6 days and January is the driest month with an average rainfall of 36.7mm over 3.9 days.

Relative humidity varies notably across the year. Mean 9am relative humidity ranges from 53% in January to 88% in June and July. Mean 3pm relative humidity levels range from 27% in January to 68% in July.

Wind speeds during the cooler months show a greater spread between the 9am and 3pm conditions compared to the warmer months. Mean 9am wind speeds range from 7.3 kilometres per hour (km/h) in June to 15.5km/h in November. Mean 3pm wind speeds range from 11.8km/h in May to 18.7km/h in December.

Table 4-1: Monthly climate statistics summary – Rutherglen Research weather station

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Temperature													
Mean max. temp. (°C)	31.4	30.8	27.4	21.9	17.0	13.4	12.4	14.0	17.2	21.0	25.4	29.2	21.8
Mean min. temp. (°C)	13.8	13.9	11.0	7.1	4.3	2.5	2.1	2.7	4.2	6.2	8.7	11.5	7.3
Rainfall													
Rainfall (mm)	36.7	37.8	38.7	40.2	51.5	56.6	61.7	60.8	54.3	57.8	45.0	44.4	586.9
No. of rain days (≥1mm)	3.9	3.6	4.0	5.2	7.1	8.3	9.6	9.8	7.7	7.2	5.5	4.8	76.7
9am conditions													
Mean temp. (°C)	22.8	22.2	19.1	14.4	9.9	6.9	6.1	7.9	11.4	15.0	18.2	21.3	14.6
Mean R.H. (%)	53	57	62	73	85	88	88	84	77	69	62	55	71
Mean W.S. (km/h)	14.4	12.1	11.9	9.8	7.8	7.3	8.4	11.2	13.4	14.4	15.5	14.8	11.8
3pm conditions													
Mean temperature (°C)	29.7	29.4	26.5	21.3	16.7	13.1	11.9	13.5	16.1	19.8	23.9	26.9	20.7
Mean R.H. (%)	27	31	34	43	57	67	68	61	57	48	38	30	47
Mean W.S. (km/h)	17.7	14.8	14.9	13.0	11.8	12.0	12.9	14.9	16.1	16.4	17.3	18.7	15.0

Source: **Bureau of Meteorology, 2018**

R.H. – Relative Humidity, W.S. – wind speed

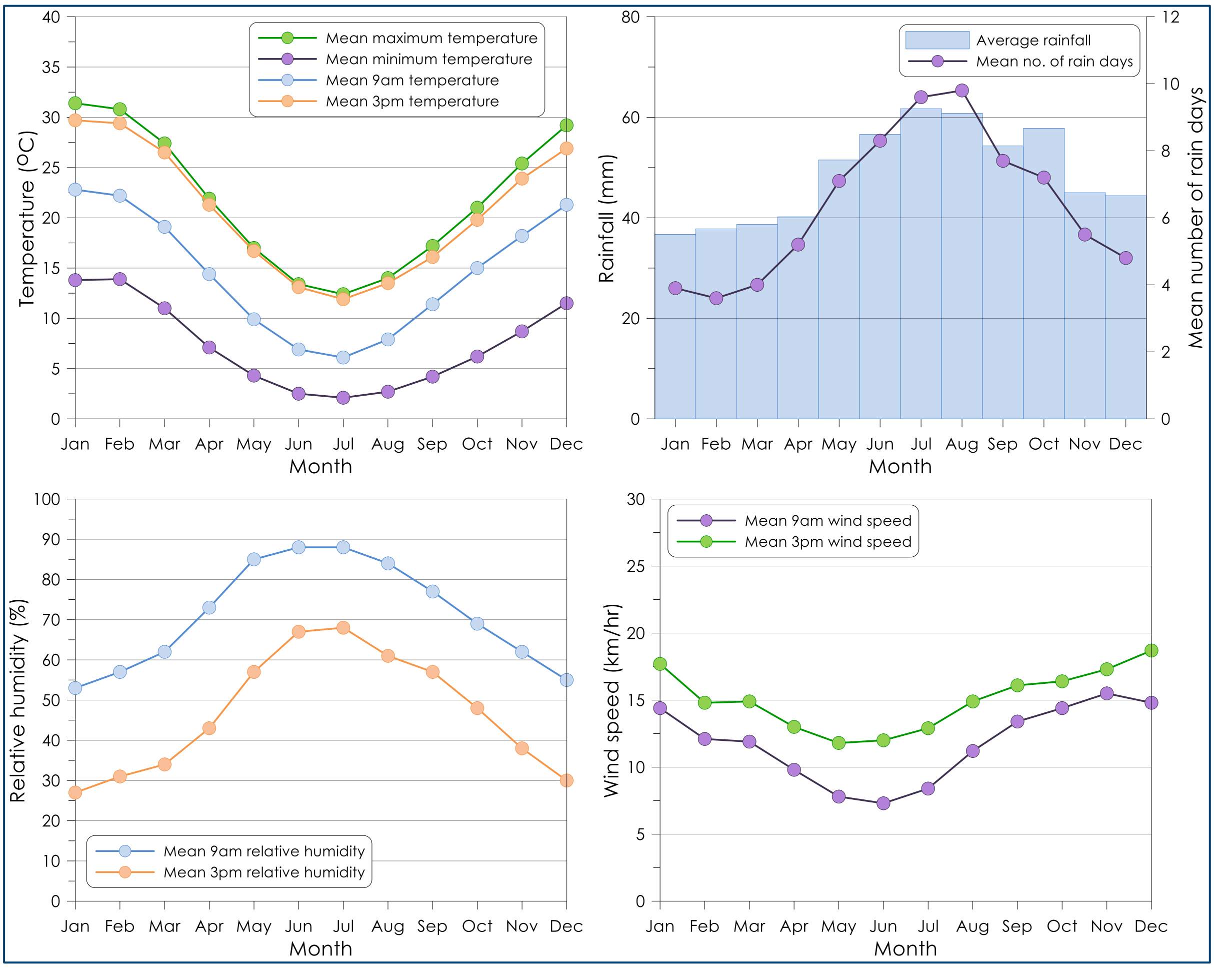

Figure 4-1: Monthly climate statistics summary – Rutherglen Research weather station

4.2 Local meteorological conditions

Annual and seasonal windroses for the Rutherglen Research weather station during the 2013 calendar period are presented in **Figure 4-2**. The 2013 calendar year was selected as the meteorological year for the dispersion modelling based on analysis of long-term data trends in meteorological data recorded for the area as outlined in **Appendix A**.

Stronger winds take place during spring and summer. Winds from the southwest quadrant are typically stronger than winds from other directions. On an annual basis, the winds come mainly from the east-northeast and the southwest.

In summer, winds are typically from the southwest and northeast quadrants, with stronger winds from the southwest. The autumn distribution is similar to the annual distribution but with weaker winds coming from the southwest. During winter, winds are typically from the northeast quadrant and the west, with more frequent winds from the northeast. Spring experiences frequent winds coming from the east-northeast and the southwest.

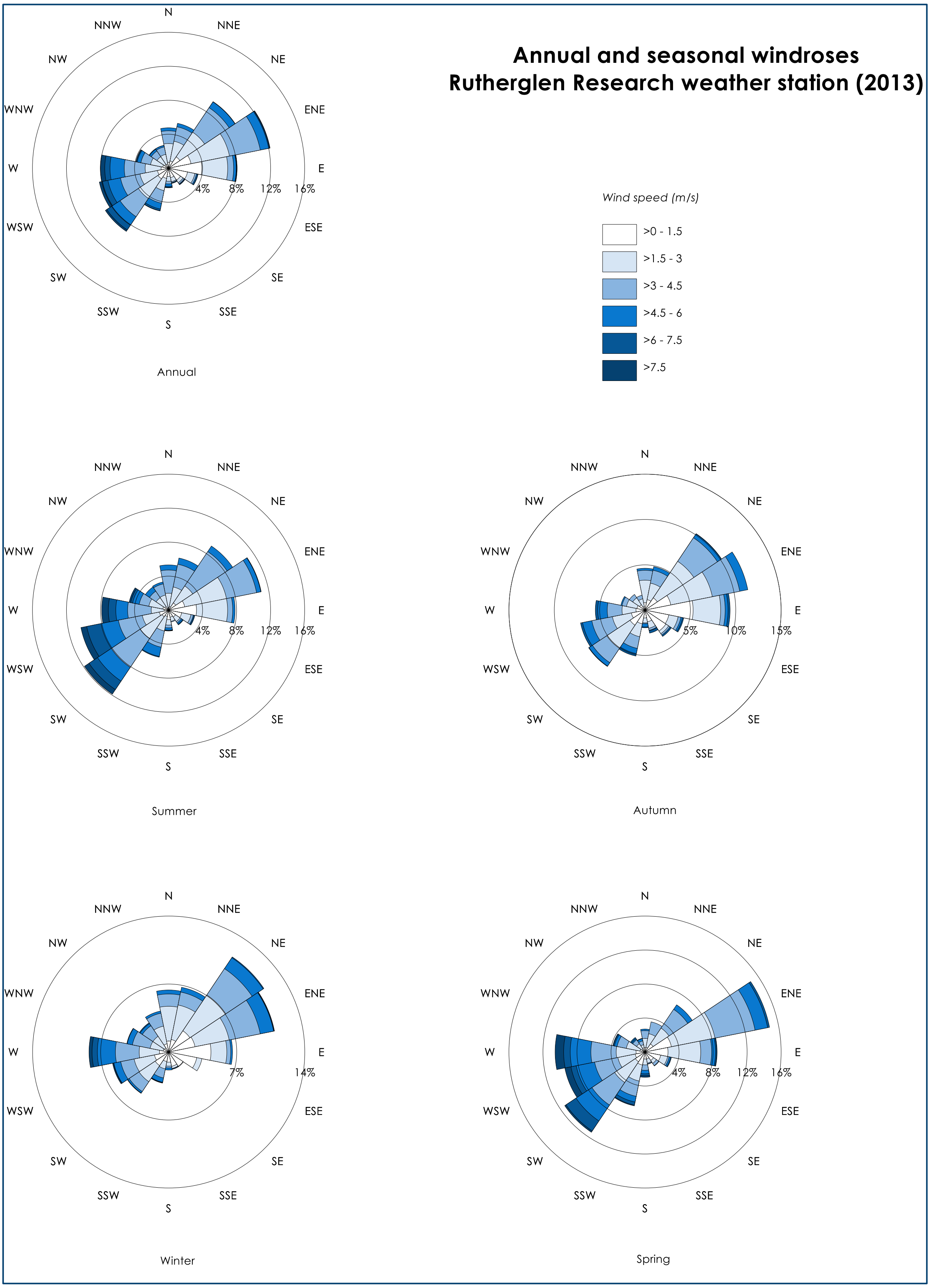

Figure 4-2: Annual and seasonal windroses – Rutherglen Research weather station (2013)

4.3 Local air quality monitoring

The main sources of air pollutants in the area surrounding the project include emissions from local anthropogenic activities such as various commercial or industrial activities, motor vehicle exhaust and domestic wood heaters.

Ambient air quality monitoring data from the project site are not available. Therefore the available data from the nearest air quality monitors operated by the NSW Office of Environment and Heritage (OEH) were used to quantify the existing background level for assessed pollutants at the project site.

The NSW OEH air quality monitors at Albury and Wagga Wagga North are approximately 28 km and 119km, respectively, from the site. In comparison to the project site, these monitors are positioned in more densely populated urban centres and would likely have a higher influence of anthropogenic sources which contribute to the overall air quality level.

4.3.1 PM_{10} monitoring

A summary of the available data from the NSW OEH monitoring stations is presented in **Table 4-2**. Recorded 24-hour average PM_{10} concentrations are presented in **Figure 4-3**.

A review of **Table 4-2** indicates that the annual average PM_{10} concentrations for each monitoring station were below the relevant criterion of 25 µg/m³. The maximum 24-hour average PM_{10} concentrations recorded at these stations were found on occasion to exceed the relevant criterion of 50 µg/m³ during the review period (see **Figure 4-3**).

Table 4-2: Summary of PM_{10} levels from NSW OEH monitoring (µg/m³)

Year	Albury	Wagga Wagga North	Criterion
	Annual average		
2012	14.3	18.8	**25**
2013	15.8	22.1	**25**
2014	15.9	20.7	**25**
2015	14.6	19.9	**25**
2016	15.1	20.6	**25**
2017	15.8	20.6	**25**
	Maximum 24-hour average		
2012	**54.4**	**67.2**	**50**
2013	**59.2**	**110.7**	**50**
2014	**159.6**	**88.2**	**50**
2015	**92.5**	**145.1**	**50**
2016	**51**	**114.7**	**50**
2017	48.8	**171.6**	**50**

It can be seen from **Figure 4-3** that PM_{10} concentrations are nominally highest in the spring and summer months with the warmer weather raising the potential for drier ground elevating the occurrence of windblown dust, bushfires and increased pollen levels.

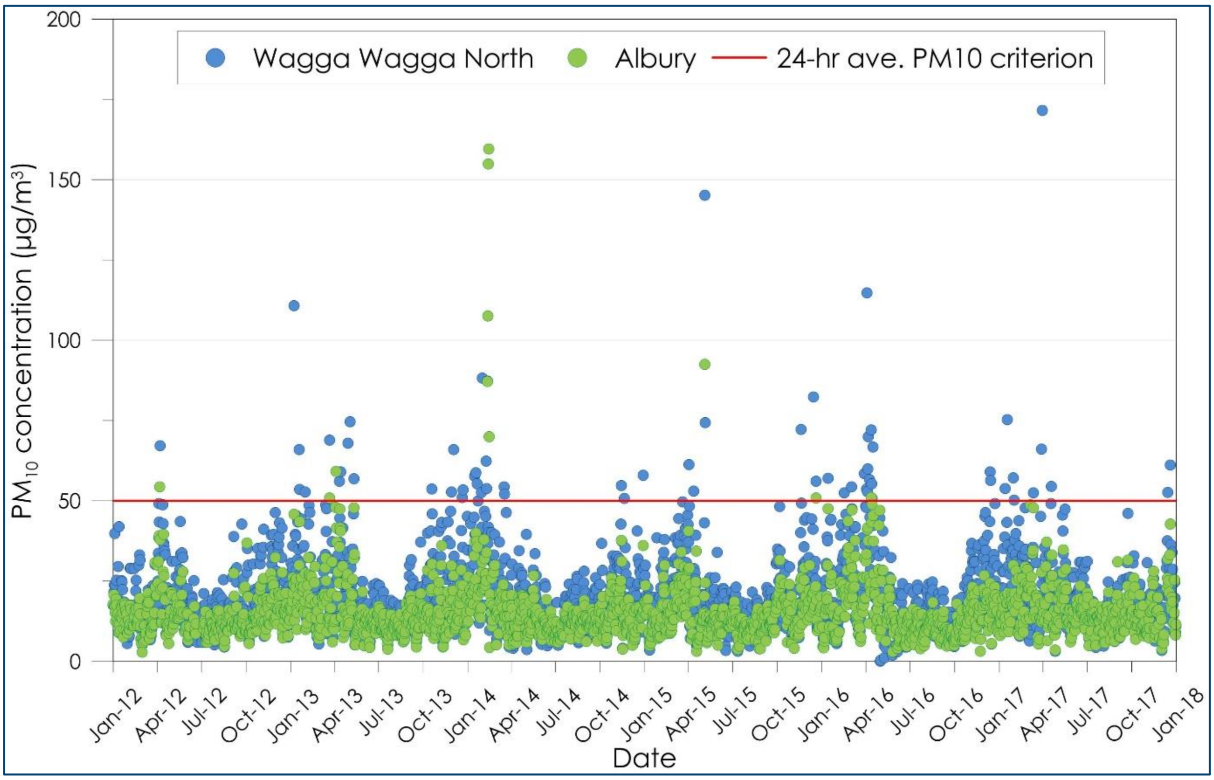

Figure 4-3: 24-hour average PM_{10} concentrations

4.3.2 $PM_{2.5}$ monitoring

A summary of the $PM_{2.5}$ readings from the NSW OEH monitoring stations is presented in **Table 4-3**. The recorded 24-hour average $PM_{2.5}$ concentrations are presented in **Figure 4-4**.

Table 4-3 indicates that the annual average $PM_{2.5}$ concentration for the Wagga Wagga North monitoring station was above the annual average criterion of 8 µg/m³ in 2012 and 2017. For all other periods the annual average $PM_{2.5}$ concentrations were below the criterion.

Data were only available for the Albury monitoring station in 2017, when it commenced monitoring. The available monitoring results indicate levels below the annual average criterion.

It can be seen from **Figure 4-4** that $PM_{2.5}$ concentrations are higher in the cooler months compared to the warmer months which can be attributed to the contribution of wood smoke emitted by wood heaters and other combustion sources.

Table 4-3: Summary of $PM_{2.5}$ levels from NSW OEH monitoring (µg/m³)

Year	Albury[(1)]	Wagga Wagga North	Criterion
	Annual average		
2012	-	**8.7**	**8**
2013	-	7.9	**8**
2014	-	7.5	**8**
2015	-	7.6	**8**
2016	-	7.4	**8**
2017	7.3	**8.1**	**8**
	Maximum 24-hour average		
2012	-	23.2	**25**
2013	-	**29.9**	**25**
2014	-	**27.6**	**25**
2015	-	24.2	**25**
2016	-	**28.1**	**25**
2017	18.7	**32.5**	**25**

[(1)]Data available from February 2017

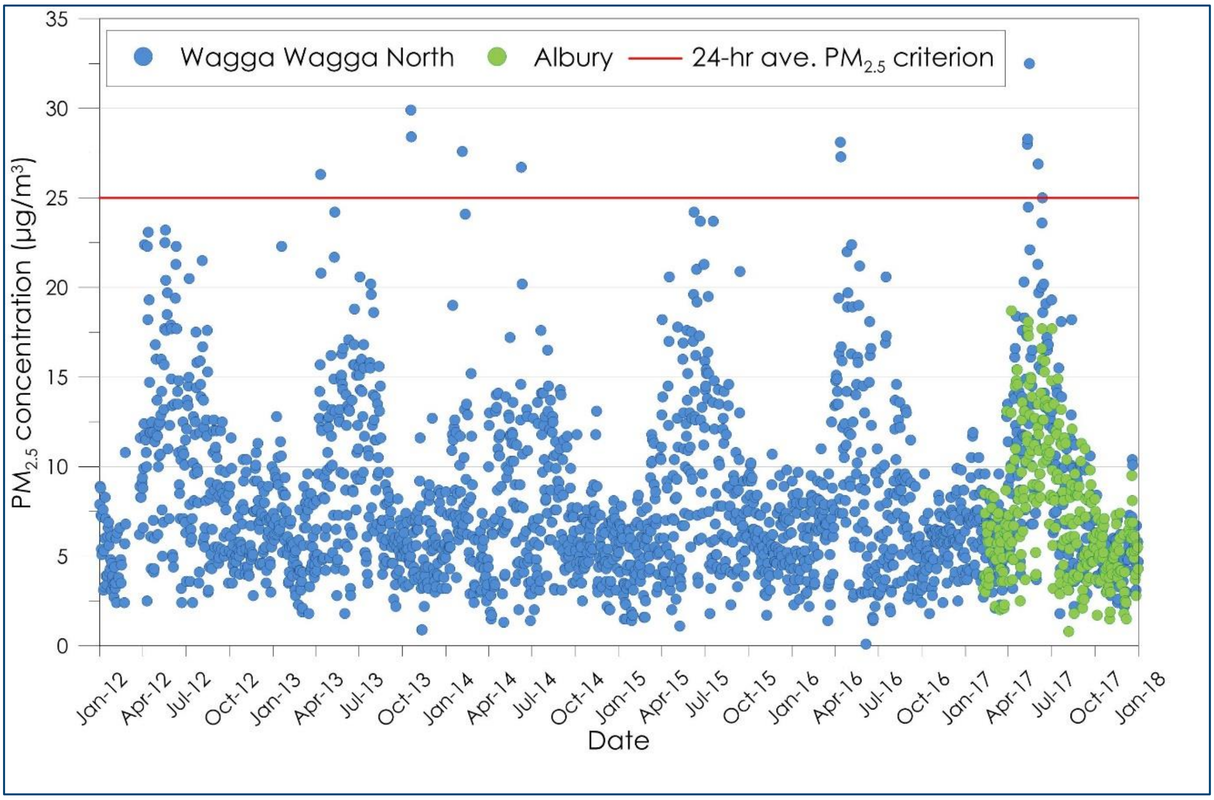

Figure 4-4: 24-hour average $PM_{2.5}$ concentrations

4.3.3 Estimated background dust levels

4.3.3.1 PM_{10} and $PM_{2.5}$ concentrations

As outlined above, there are no readily available site specific monitoring data, and therefore, the background dust levels around the project site were estimated to be similar to those recorded at the nearest NSW OEH monitoring sites.

Annual average PM_{10} value from the Albury monitoring station for the 2013 calendar year and the available annual average $PM_{2.5}$ value from the Albury monitoring station for the 2017 calendar year were used to represent the background levels for the project (see **Table 4-2** and **Table 4-3**).

The background air quality levels for the project site would likely be lower than in the urban environment of Albury and hence the applied background levels are considered conservative.

4.3.3.2 TSP and Deposited dust

In the absence of data, estimates of the annual average background TSP and deposited dust concentrations can be determined from a relationship between PM_{10}, TSP and deposited dust concentrations and the measured PM_{10} levels.

This relationship assumes that an annual average PM_{10} concentration of 25 µg/m^3 corresponds to a TSP concentration of 90 µg/m^3 and a dust deposition value of 4 g/m^2/month. This assumption is based on the NSW EPA air quality impact criteria.

Applying this relationship with the measured annual average PM_{10} concentration of 15.8 µg/m^3 indicates an approximate annual average TSP concentration and deposition value of 56.9 µg/m^3 and 2.5 g/m^2/month, respectively.

4.3.3.3 Summary of background dust levels

The annual average background air quality levels applied in this assessment are as follows:

- $PM_{2.5}$ concentrations – 7.3 µg/m^3;
- PM_{10} concentrations – 15.8 µg/m^3;
- TSP concentrations – 56.9 µg/m^3; and,
- Deposited dust levels – 2.5 g/m^2/month.

5 DISPERSION MODELLING APPROACH

5.1 Introduction

The following sections are included to provide the reader with an understanding of the model and modelling approach applied for the assessment.

CALPUFF is an advanced "puff" air dispersion model which can deal with the effects of complex local terrain on the dispersion meteorology over the entire modelling domain in a three-dimensional, hourly varying time step. The model setup used is in general accordance with methods provided in the NSW EPA document *Generic Guidance and Optimum Model Setting for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia'* (**TRC, 2011**).

5.2 Modelling methodology

Modelling was undertaken using a combination of the CALPUFF Modelling System and The Air Pollution Model (TAPM). The CALPUFF Modelling System includes three main components: CALMET, CALPUFF and CALPOST and a large set of pre-processing programs designed to interface the model to standard, routinely available meteorological and geophysical datasets.

5.2.1 Meteorological modelling

TAPM was applied to the available data to generate a 3D upper air data file for use in CALMET. The centre of analysis for TAPM was 36 deg 0.5 min south and 146 deg 39.5 min east (469750 mE, 6014764 mN). The simulation involved an outer grid of 30 km, with three nested grids of 10 km, 3 km and 1 km with 35 vertical grid levels.

CALMET modelling used a nested approach where the 3D wind field from the coarser grid outer domain is used as the initial guess (or starting) field for the finer grid inner domain. The CALMET initial domain was run on a 20 x 20 km area with a 0.4 km grid resolution and refined for a final domain on a 10 x 10km area with 0.1 km grid resolution.

The 2013 calendar year was selected as the meteorological year for the dispersion modelling based on analysis of long-term data trends in meteorological data recorded for the area as outlined in **Appendix A**.

Local land use and detailed topographical information was included in the simulation to produce realistic fine scale flow fields (such as terrain forced flows) in surrounding areas, as shown in **Figure 5-1.**

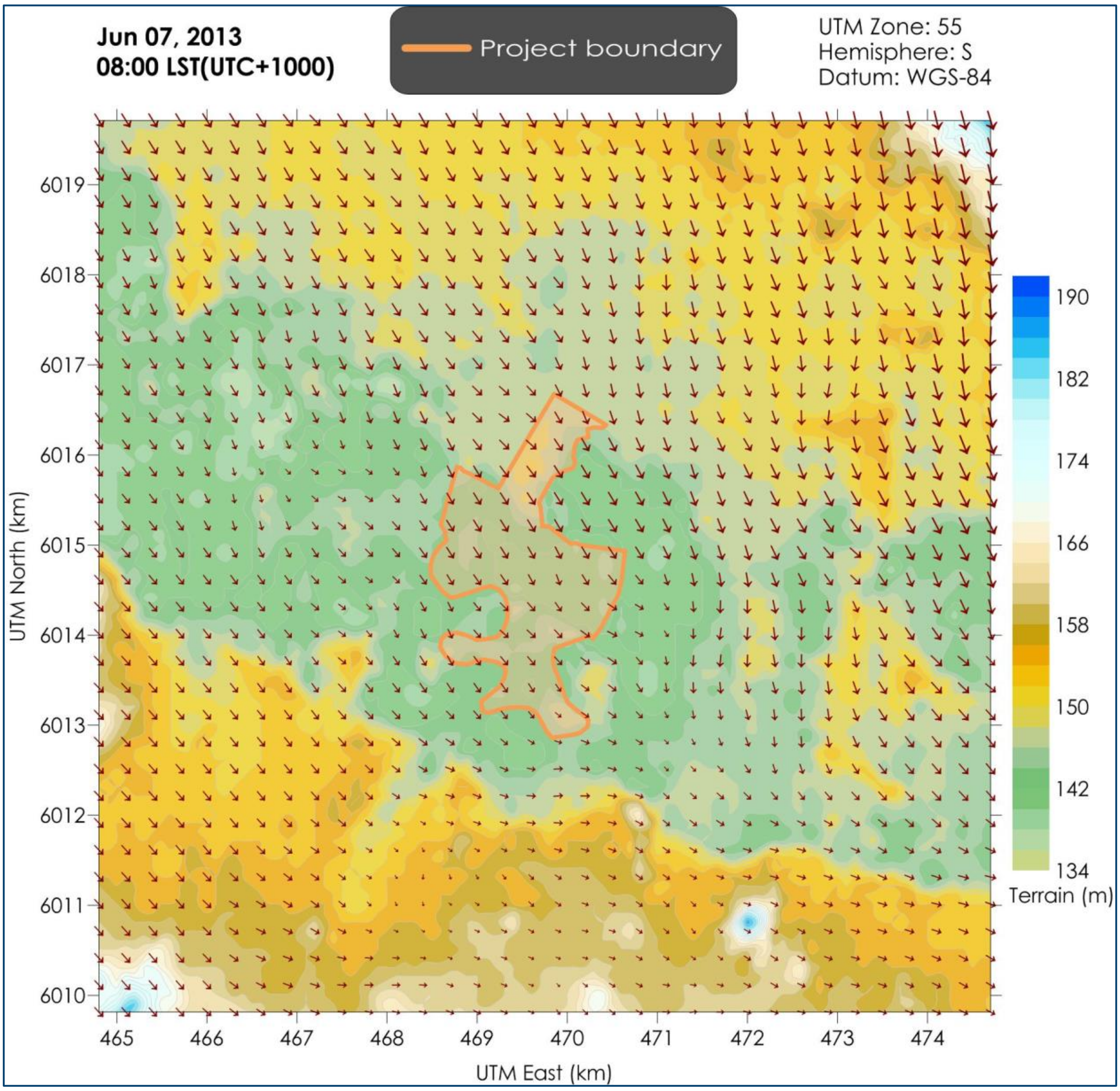

Figure 5-1: Representative snapshot of wind field for the project

CALMET generated meteorological data were extracted from a point within the CALMET domain and are graphically represented in **Figure 5-2** and **Figure 5-3**.

Figure 5-2 presents the annual and seasonal windroses from the CALMET data. Overall, the windroses generated in the CALMET modelling reflect the expected wind distribution patterns of the area as determined based on the available measured data and the expected terrain effects on the prevailing winds.

Figure 5-3 includes graphs of the temperature, wind speed, mixing height and stability classification over the modelling period and show sensible trends considered to be representative of the area.

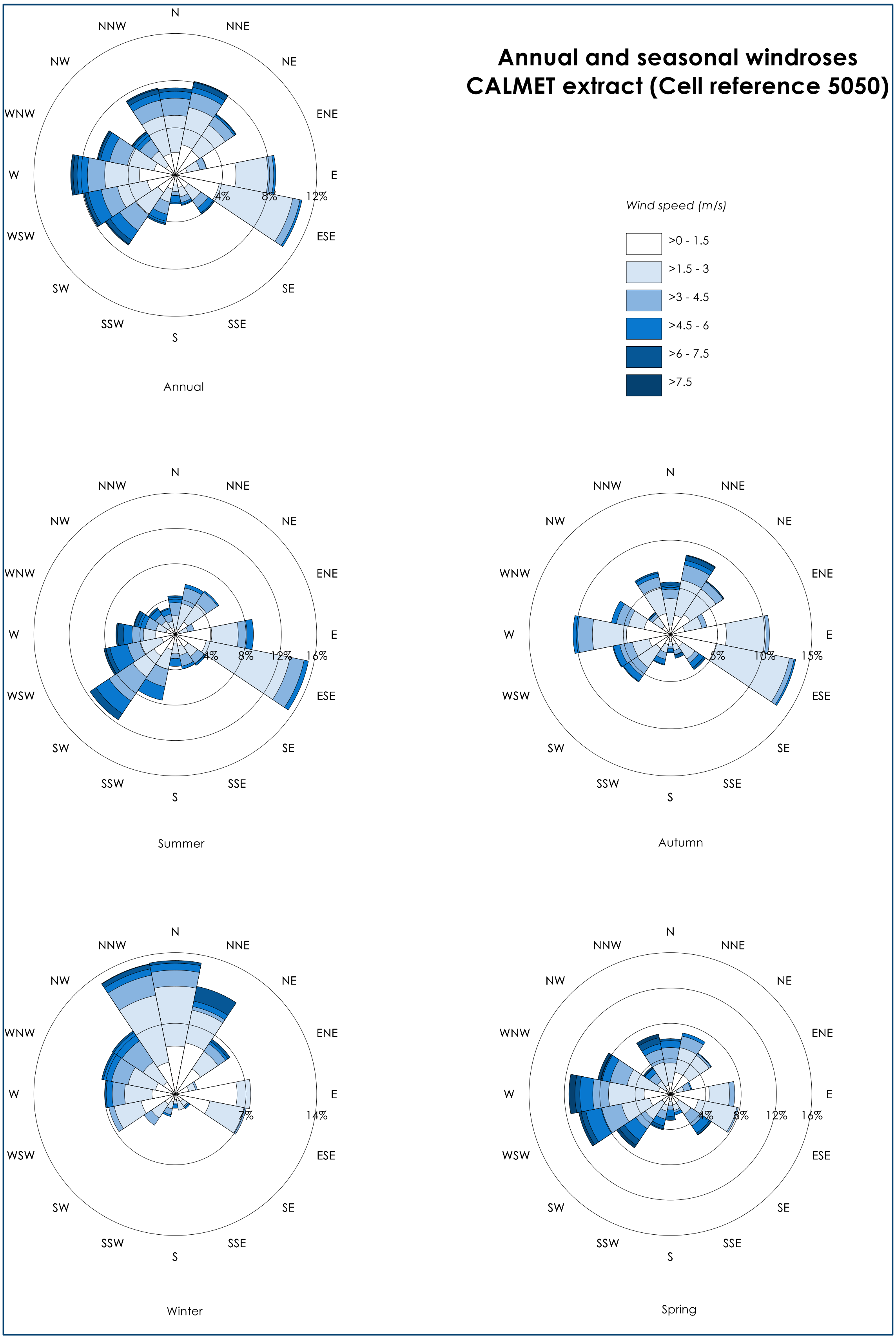

Figure 5-2: Annual and seasonal windroses from CALMET (Cell reference 5050)

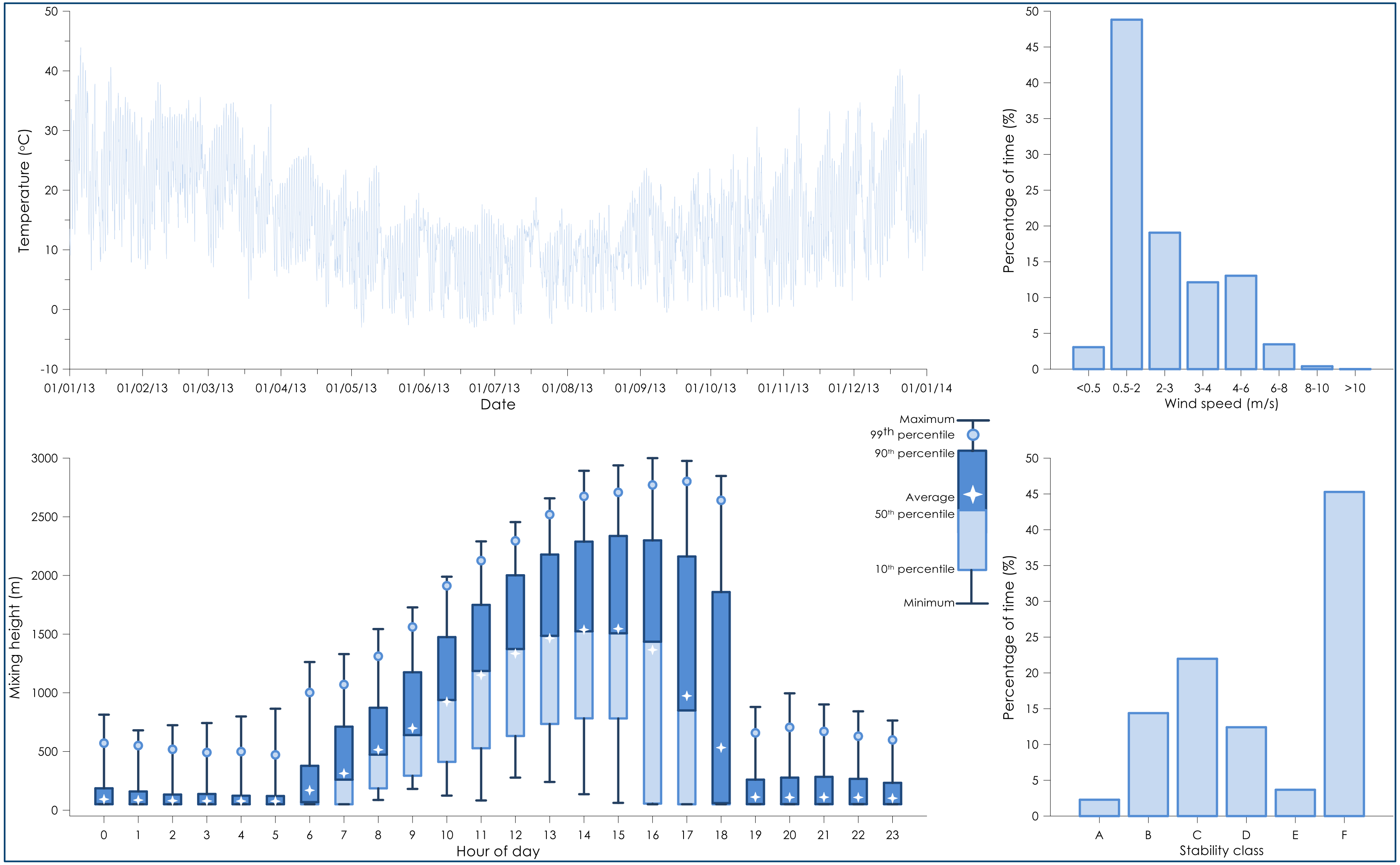

Figure 5-3: Meteorological analysis of CALMET (Cell Ref 5050)

5.2.2 Dispersion modelling

Emissions from each operational activity of the project were represented by a series of volume sources and were included in the CALPUFF model via an hourly varying emission file. Meteorological conditions associated with dust generation (such as wind speed) and levels of dust generating activity were considered in calculating the hourly varying emission rate for each source.

It should be noted that as a conservative measure, the effect of the precipitation rate (rainfall) in reducing dust emissions has not been considered in this assessment.

5.3 Emission estimation

The significant dust generating activities associated with operation of the project are identified as: loading/unloading of material, vehicles travelling on-site, and windblown dust generated from stockpiles. The on-site vehicle and plant equipment also have the potential to generate particulate emissions from the diesel exhaust.

Dust emission estimates for the project have been calculated by analysing the various types of dust generating activities taking place and utilising suitable emission factors sourced from US EPA developed documentation (**US EPA, 1985 and Updates**).

The estimated dust emissions for activities associated with the operation are presented in **Table 5-1**. Detailed calculations of the dust emission estimates are provided in **Appendix B**.

Table 5-1: Estimated annual emissions for the project (kg/year)

ACTIVITY	TSP emission	PM_{10} emission	$PM_{2.5}$ emission
Excavator loading topsoil to haul truck	105	50	8
Hauling to topsoil emplacement area	1,502	383	38
Emplacing topsoil at stockpile	105	50	8
Excavator loading OB to haul truck	43	20	3
Hauling to OB to emplacement area	611	156	16
Emplacing at OB dump	43	20	3
Loading sand/gravel material truck	483	228	35
Hauling to sand/gravel to processing stockpile	6,885	1,755	175
Unloading sand/gravel to stockpile at processing area	483	228	35
Loading sand/gravel to crusher/ screen	483	228	35
Crushing sand/gravel material	891	396	67
Screening sand/gravel material	4,125	1,419	309
Unloading processed sand/gravel material to stockpile	84	40	6
Rehandle processed sand/gravel material at stockpiles	84	40	6
Loading processed sand/gravel material to truck	76	36	5
Hauling product sand/gravel material offsite	20,259	5,163	516
Wind erosion - whole site	36,049	18,024	2,704
Exhaust emissions	727	727	705
Total	**73,037**	**28,963**	**4,673**

6 DISPERSION MODELLING RESULTS

The dispersion model predictions presented in this section include those for the operation of the project is isolation (incremental impact) and the operation of the project with consideration of other sources (total (cumulative) impact). The results show the predicted:

- Maximum 24-hour average $PM_{2.5}$ and PM_{10} concentrations;
- Annual average $PM_{2.5,}$ PM_{10} and TSP concentrations; and,
- Annual average dust (insoluble solids) deposition rates.

It is important to note that when assessing impacts per the maximum 24-hour average levels, these predictions are based on the highest predicted 24-hour average concentrations that were modelled at each point within the modelling domain for the worst day (i.e. a 24-hour period) in the one year long modelling period. The predictions do not represent just one particular day, but a combination of days and is an overestimation of what would actually occur.

Associated isopleth diagrams of the dispersion modelling results are presented in **Appendix C**.

6.1 Dust concentrations

Table 6-1 presents the predicted incremental particulate dispersion modelling results at each of the assessed sensitive receptor locations. The results show minimal incremental effects would arise at the sensitive receptor locations due to the proposed operation.

Table 6-1: Particulate dispersion modelling results for sensitive receptor – Incremental impact

Receptor ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/month)
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average
	Air quality impact criteria					
	-	-	-	-	-	2
R1	0.4	<0.1	2.6	0.3	0.6	<0.1
R2	0.8	0.1	6.4	0.8	2.1	0.1
R3	0.8	0.1	5.9	0.6	1.5	0.1
R4	1.2	0.2	8.5	1.3	3.2	0.1
R5	0.5	<0.1	3.1	0.3	0.6	<0.1

The cumulative (total) impact is defined as the modelling impact associated with the operation of the project combined with the estimated ambient background levels in **Section 4.3.3**. The predicted cumulative annual average $PM_{2.5}$, PM_{10}, TSP and dust deposition levels due to the project with the estimated background levels are presented in **Table 6-2**.

Cumulative 24-hour $PM_{2.5}$ and PM_{10} impacts are considered in detail in **Section 6.2**.

The results in **Table 6-2** indicate that all of the assessed sensitive receptors are predicted to experience levels below the relevant criteria for each of the assessed dust metrics.

Table 6-2: Particulate dispersion modelling results for sensitive receivers – Cumulative impact

Receptor ID	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	Annual average			
	Air quality impact criteria			
	8	25	90	4
R1	7.3	16.1	57.5	2.5
R2	7.4	16.6	59.0	2.6
R3	7.4	16.4	58.4	2.6
R4	7.5	17.1	60.1	2.6
R5	7.3	16.1	57.5	2.5

6.2 Assessment of Total (Cumulative) 24-hour average $PM_{2.5}$ and PM_{10} Concentrations

An assessment of total (cumulative) 24-hour average $PM_{2.5}$ and PM_{10} impacts was undertaken in general accordance with the methods outlined in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA, 2017**).

A Level 2 contemporaneous assessment approach where the measured background levels are added to the day's corresponding predicted dust level from the project has been applied. Ambient (background) $PM_{2.5}$ and PM_{10} concentration data corresponding with the year of modelling (2013) from the NSW OEH monitoring site at Wagga Wagga North and at Albury respectively, have been applied in this case to represent the prevailing background levels in the vicinity of the project and representative sensitive receptor locations.

Table 6-3 provides a summary of the findings from the Level 2 assessment at representative receptor locations for both PM_{10} and $PM_{2.5}$. Detailed tables of the assessment results are provided in **Appendix D**.

The results indicate that the project does not increase the number of days above the 24-hour average criterion at the assessed receptors.

Table 6-3: NSW EPA contemporaneous assessment - maximum number of additional days above 24-hour average criterion

Receptor ID	PM_{10}	$PM_{2.5}$
R1	0	0
R2	0	0
R3	0	0
R4	0	0
R5	0	0

Time series plots of the predicted cumulative 24-hour average PM_{10} and $PM_{2.5}$ concentrations for R1 and R4 are presented in **Figure 6-1** and **Figure 6-2**. The orange bars in the figures represent the contribution from the project and the blue bars represent the background levels. It is clear from the figures that the project has a relatively small influence.

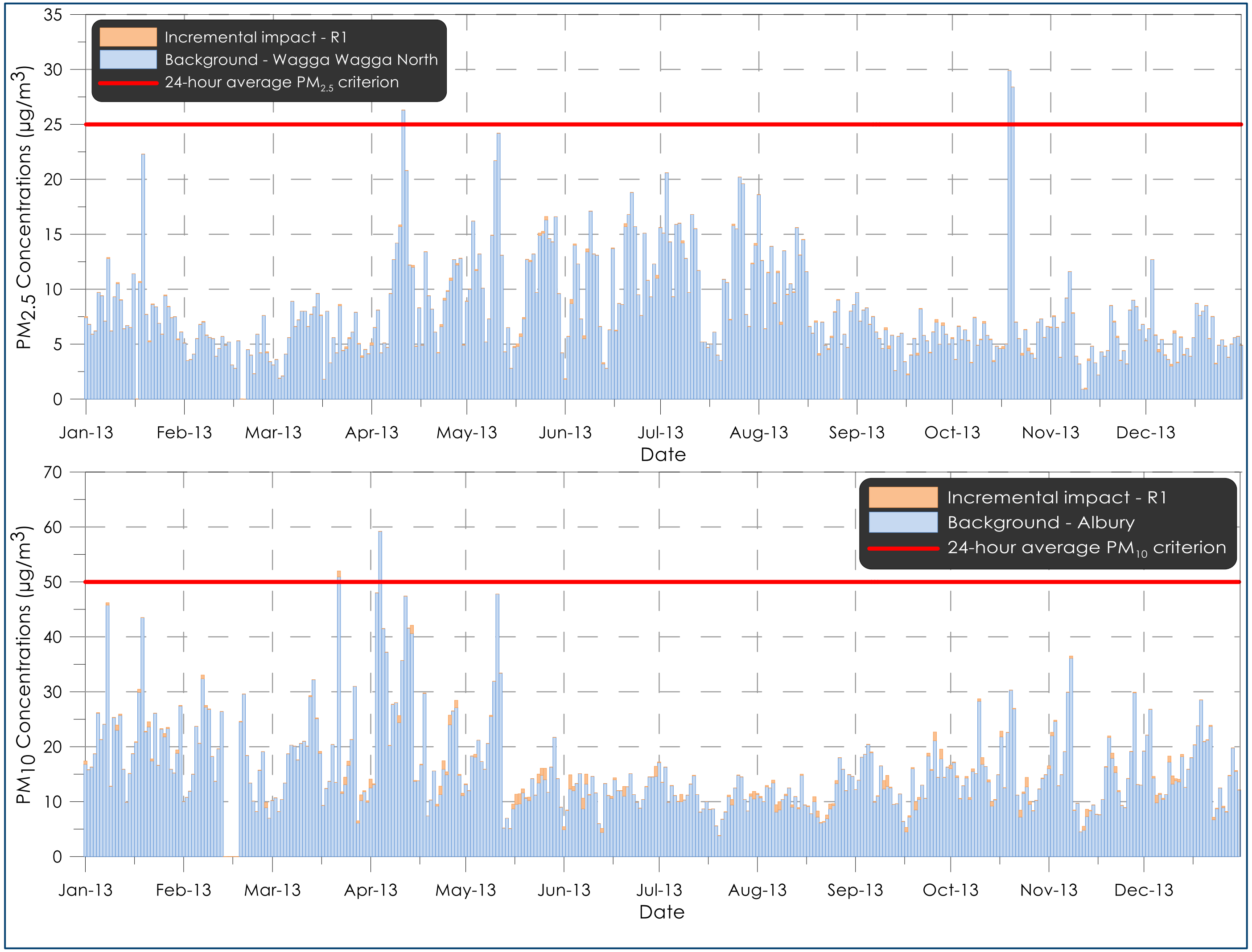

Figure 6-1: Time series plots of predicted cumulative 24-hour average $PM_{2.5}$ and PM_{10} concentrations for R1

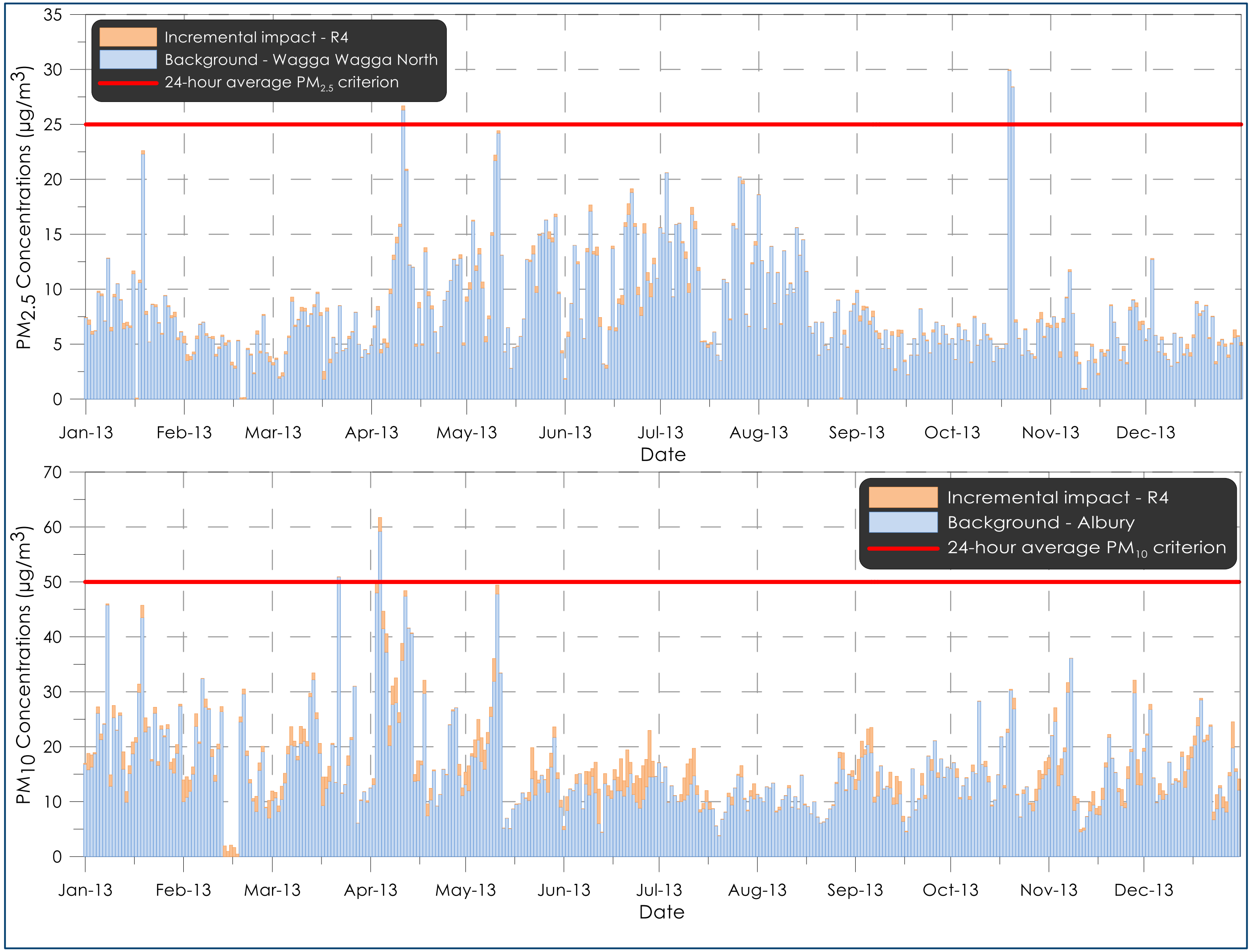

Figure 6-2: Time series plots of predicted cumulative 24-hour average $PM_{2.5}$ and PM_{10} concentrations for R4

7 DUST MITIGATION AND MANAGEMENT

The proposed operations at the project have the potential to generate dust emissions. To ensure activities associated with the project have a minimal effect on the surrounding environment and at sensitive receptor locations, it is recommended that appropriate operational and physical mitigation measures should be implemented where feasible and reasonable as outlined in **Table 7-1**.

Table 7-1: Potential operational dust mitigation options

Source	Mitigation Measure
General	Activities to be assessed during adverse weather conditions and modified as required (e.g. cease activity where reasonable levels of dust cannot be maintained using the available means)
	Weather forecast to be checked prior to undertaking material handling or processing
	Engines of on-site vehicles and plant to be switched off when not in use
	Vehicles and plant are to be fitted with pollution reduction devices where practicable
	Vehicles are to be maintained and serviced according to manufacturer's specifications
	Visual monitoring of activities is to be undertaken to identify dust generation
Exposed areas / stockpiles	The extent of exposed surfaces and stockpiles is to be kept to a minimum
	Exposed areas and stockpiles are either to be covered or are to be dampened with water as far as is practicable if dust emissions are visible, or there is potential for dust emissions outside operating hours.
	Minimise dust generation by undertaking rehabilitation earthworks when topsoil and subsoil stockpiles are moist and/or wind speed is below 10 m/s.
Material handling	Reduce drop heights from loading and handling equipment where practical
	Dampen material when excessively dusty during handling
Hauling activities	Any hardstand on-site or public roads to be swept/cleaned regularly as required etc.
	Vehicle traffic is to be restricted to designated routes
	Speed limits are to be enforced
	Vehicle loads are to be covered when travelling off-site

It is anticipated that the project would develop a suitable Air Quality Management Plan (AQMP) for the site to assist with the management of air emissions. It is envisaged the AQMP would detail appropriate air emission control measures and mechanisms applied and as well as other management measures to minimise the potential for air emissions. The air emission controls applied at the site would be regularly assessed to ensure they are working effectively, any required modifications or adjustments to the air emission control measures would be revised on a regular basis and documented in the AQMP.

The key performance indicators for the applied air emission controls would be through visual means indicated by the visual dust plumes generated from each activity. The key performance indicators would be met when visual dust plumes arising from the activities are considered minimal or non-existent and that no record of complaints regarding dust plumes and impacts have been recorded.

A complaints protocol for the Project will also be made available for any complaints received regarding air quality impacts. Any incident or complaint relating to air quality will be recorded and investigated to identify wherever possible the specific cause (which may include attended monitoring) and corrective action will be implemented where necessary and feasible to do so.

As the predicted air quality impacts associated with the Project at the surrounding sensitive receptors locations are relatively low (see **Section 6**), there is no recommendation for the establishment of a real-time ambient air quality monitoring network.

8 SUMMARY AND CONCLUSIONS

This report has assessed the potential air quality impacts associated with the proposed expansion of the sand and gravel quarry operation.

Air dispersion modelling was used to predict the potential for off-site dust impacts in the surrounding area due to the operation the project. The estimated emissions of dust applied in the modelling are likely to be conservative and would overestimate the actual impacts.

It is predicted that all the assessed air pollutants generated by construction and operation of the project would comply with the applicable assessment criteria at the sensitive receptors and therefore would not lead to any unacceptable level of environmental harm or impact in the surrounding area.

Nevertheless, the site would apply appropriate dust management measures to ensure it minimises the potential occurrence of excessive air emissions from the site.

Overall, the assessment demonstrates that even using conservative assumptions, the project can operate without causing any significant air quality impact at sensitive receivers in the surrounding environment.

9 REFERENCES

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"NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining", Katestone Environmental Pty Ltd prepared for DECCW, 2010.

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"Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales", NSW EPA, January 2017

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"Compilation of Air Pollutant Emission Factors", AP-42, Fourth Edition United States Environmental Protection Agency, Office of Air and Radiation Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina 27711.

Appendix A

Selection of Meteorological Year

Selection of meteorological year

A statistical analysis of the latest five years of meteorological data from the nearest BoM weather station with suitable available data, Rutherglen Research, is presented in **Table A-1**. The standard deviation of five years of meteorological data spanning 2012 to 2016 was analysed against the mean measured wind speed, temperature and relative humidity.

The analysis indicates that 2013 is closest to the average for wind speed and temperature and 2012 is closest for relative humidity.

Figure A-1 shows the frequency distributions for wind speed, temperature and relative humidity of the 2013 year compared with the mean of the 2012 to 2016 data set. The 2013 year data appear to be well aligned with the mean data.

Therefore, based on this analysis it was determined that 2013 is generally representative of the long-term trends compared to other years and is thus suitable for the purpose of modelling.

Table A-1: Statistical analysis results for Rutherglen Research

Year	Wind speed	Temperature	Relative humidity
2012	0.3	0.9	5.0
2013	0.3	0.8	5.3
2014	0.3	1.0	7.1
2015	0.4	1.2	5.2
2016	0.3	0.9	6.4

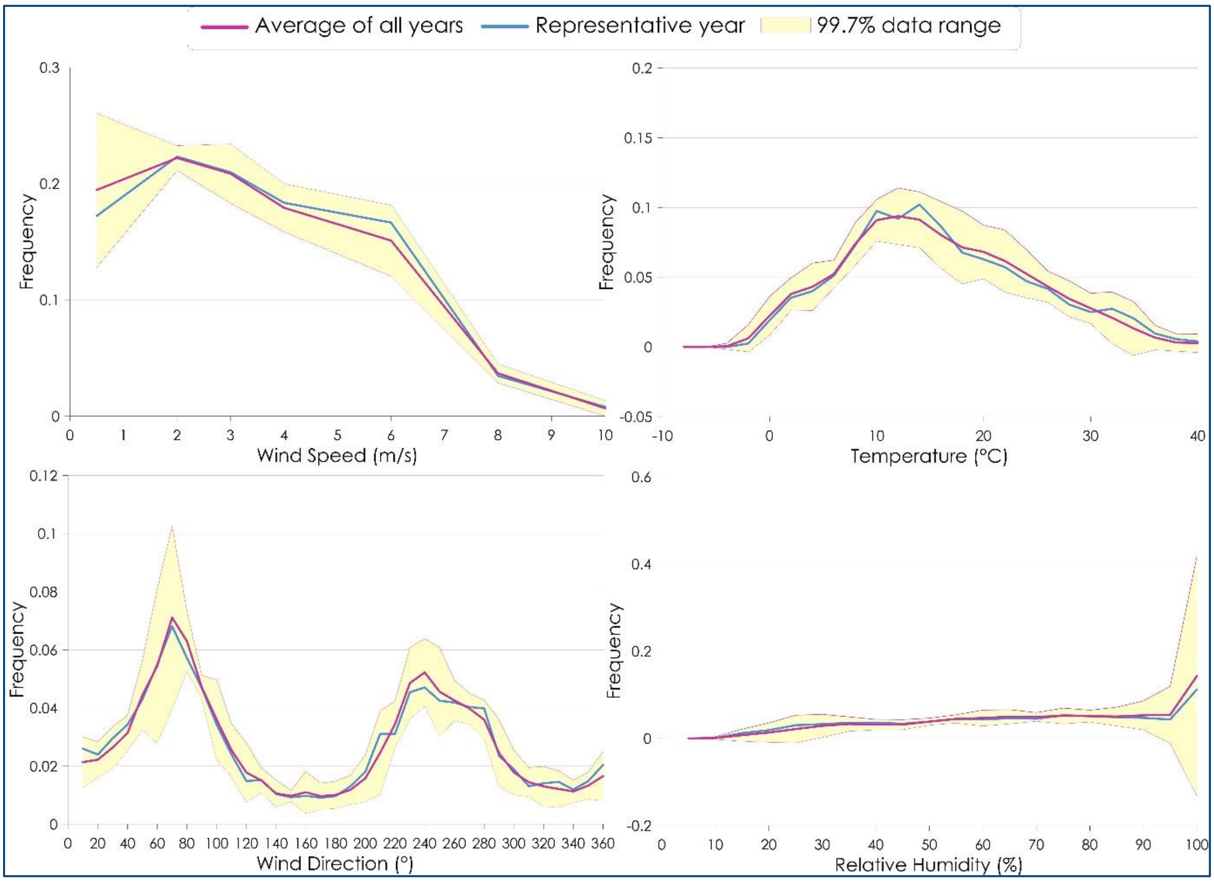

Figure A-1: Frequency distributions for wind speed, wind direction, temperature and relative humidity

Appendix B
Emission Calculation

Emission Calculation

The production schedule and quarry plan designs provided by the Applicant have been combined with emissions factor equations that relate to the quantity of dust emitted from particular activities based on intensity, the prevailing meteorological conditions and composition of the material being handled.

Emission factors and associated controls have been sourced from:

- United States (US) EPA AP42 Emission Factors (**US EPA, 1985 and Updates**);
- National Pollutant Inventory (NPI) documents "Emission Estimation Technique Manual for Mining, Version 3.1" (**NPI, 2012**); and,
- Office of Environment and Heritage document, "NSW Coal Mining Benchmarking Study: International Best Practise Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining", prepared by Katestone Environmental (**Katestone Environmental, 2010**).

The emission factor equations used for each dust generating activity are outlined in **Table B-1** below. Detailed emission inventory for the modelled year is presented in **Table B-2.**

Control factors include the following:

- Hauling on unpaved surfaces – 75% control for watering of trafficked areas.

Table B-1: Emission factor equations

Activity	Emission factor equation		
	TSP	PM_{10}	$PM_{2.5}$
Loading / emplacing material & conveyor transfer	$EF = 0.74 \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right) kg/tonne$	$EF = 0.35 \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right) kg/tonne$	$EF = 0.053 \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right) kg/tonne$
Hauling on unsealed surfaces	$EF = \left(\frac{0.4536}{1.6093}\right) \times 4.9 \times (s/12)^{0.7} \times (1.1023 \times M/3)^{0.45} kg/VKT$	$EF = \left(\frac{0.4536}{1.6093}\right) \times 1.5 \times (s/12)^{0.9} \times (1.1023 \times M/3)^{0.45} kg/VKT$	$EF = \left(\frac{0.4536}{1.6093}\right) \times 0.15 \times (s/12)^{0.9} \times (1.1023 \times M/3)^{0.45} kg/VKT$
Crushing	$EF = 0.0027\ kg/tonne$	$EF = 0.0012\ kg/tonne$	$0.075 \times TSP$
Screening	$EF = 0.0125\ kg/tonne$	$EF = 0.0043\ kg/tonne$	$0.075 \times TSP$
Wind erosion on exposed areas, stockpiles	$EF = 850\ kg/ha/year$	$0.5 \times TSP$	$0.075 \times TSP$

EF = emission factor, U = wind speed (m/s), M = moisture content (%), s = silt content (%), VKT = vehicle kilometres travelled (km).

Table B-2: Emissions inventory

ACTIVITY	TSP emission	PM10 emission	PM2.5 emission	Intensity	Units	Emission Factor TSP	Emission Factor PM10	Emission Factor PM2.5	Units	Var. 1	Units	Var. 2	Units	Size specific EF - TSP / PM10 / PM2.5	Units	Var. 3	Units	Var. 4	Units	Var. 5	Units
Excavator loading topsoil to haul truck	105	50	8	72,000	t/y	0.00146	0.001	0.0001	kg/t	1.24	ave. $(WS/2.2)^{1.3}$	2	M.C. (%)								
Hauling to topsoil emplacement area	1,502	383	38	72,000	t/y	0.083	0.021	0.002	kg/t	37	t/load	1.2	km/return trip	2.6 / 0.7 / 0.1	kg/VKT	4.8	S.C. (%)	47	Ave GMV (t)	75	% Control
Emplacing topsoil at stockpile	105	50	8	72,000	t/y	0.00146	0.001	0.0001	kg/t	1.24	ave. $(WS/2.2)^{1.3}$	2	M.C. (%)								
Excavator loading OB to haul truck	43	20	3	29,282	t/y	0.00146	0.001	0.0001	kg/t	1.24	ave. $(WS/2.2)^{1.3}$	2	M.C. (%)								
Hauling to OB to emplacement area	611	156	16	29,282	t/y	0.083	0.021	0.002	kg/t	37	t/load	1.2	km/return trip	2.6 / 0.7 / 0.1	kg/VKT	4.8	S.C. (%)	47	Ave GMV (t)	75	% Control
Emplacing at OB dump	43	20	3	29,282	t/y	0.00146	0.001	0.0001	kg/t	1.24	ave. $(WS/2.2)^{1.3}$	2	M.C. (%)								
Loading sand/gravel material truck	483	228	35	330,000	t/y	0.00146	0.001	0.0001	kg/t	1.24	ave. $(WS/2.2)^{1.3}$	2	M.C. (%)								
Hauling to sand/gravel to processing stockpile	6,885	1,755	175	330,000	t/y	0.083	0.021	0.002	kg/t	37	t/load	1.2	km/return trip	2.6 / 0.7 / 0.1	kg/VKT	4.8	S.C. (%)	47	Ave GMV (t)	75	% Control
Unloading sand/gravel to stockpile at processing area	483	228	35	330,000	t/y	0.00146	0.001	0.0001	kg/t	1.24	ave. $(WS/2.2)^{1.3}$	2	M.C. (%)								
Loading sand/gravel to crusher/ screen	483	228	35	330,000	t/y	0.00146	0.001	0.0001	kg/t	1.24	ave. $(WS/2.2)^{1.3}$	2	M.C. (%)								
Crushing sand/gravel material	891	396	67	330,000	t/y	0.0027	0.001	0.0002	kg/t												
Screening sand/gravel material	4,125	1,419	309	330,000	t/y	0.0125	0.004	0.0009	kg/t												
Unloading processed sand/gravel material to stockpile	84	40	6	330,000	t/y	0.00025	0.000	0.0000	kg/t	1.24	ave. $(WS/2.2)^{1.3}$	7	M.C. (%)								
Rehandle processed sand/gravel material at stockpiles	84	40	6	330,000	t/y	0.00025	0.000	0.0000	kg/t	1.24	ave. $(WS/2.2)^{1.3}$	7	M.C. (%)								
Loading processed sand/gravel material to truck	76	36	5	300,000	t/y	0.00025	0.000	0.0000	kg/t	1.24	ave. $(WS/2.2)^{1.3}$	7	M.C. (%)								
Hauling product sand/gravel material offsite	20,259	5,163	516	300,000	t/y	0.270	0.069	0.007	kg/t	45	t/load	4.7	km/return trip	2.6 / 0.7 / 0.1	kg/VKT	4.8	S.C. (%)	46	Ave GMV (t)	75	% Control
Wind erosion - whole site	36,049	18,024	2,704	42.4	ha	850	425	64	kg/ha/y												
Exhaust emissions	727	727	705																		
Total emissions (kg/yr)	**73,037**	**28,963**	**4,673**																		

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Appendix C

Isopleth Diagrams

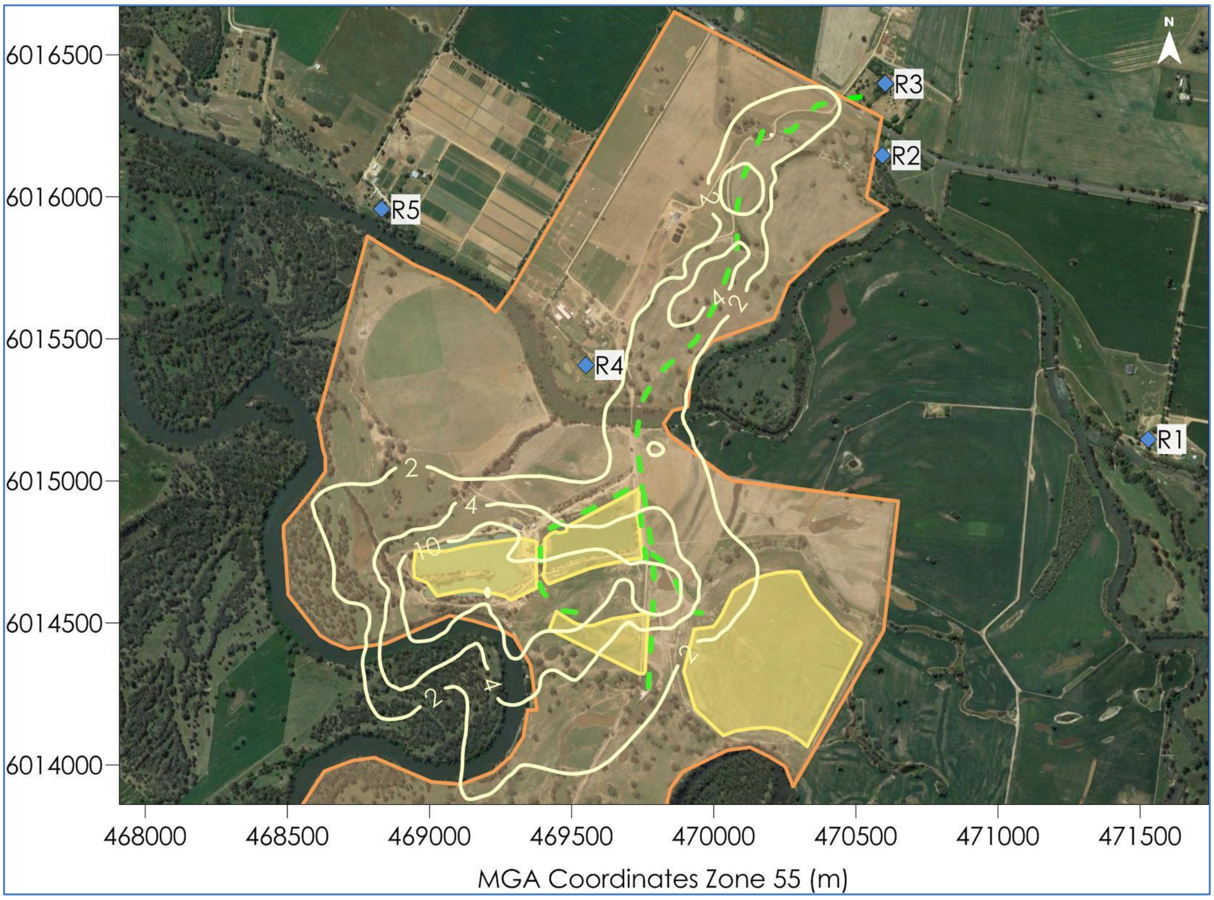

Figure C-1: Predicted incremental maximum 24-hour average $PM_{2.5}$ concentrations (µg/m³)

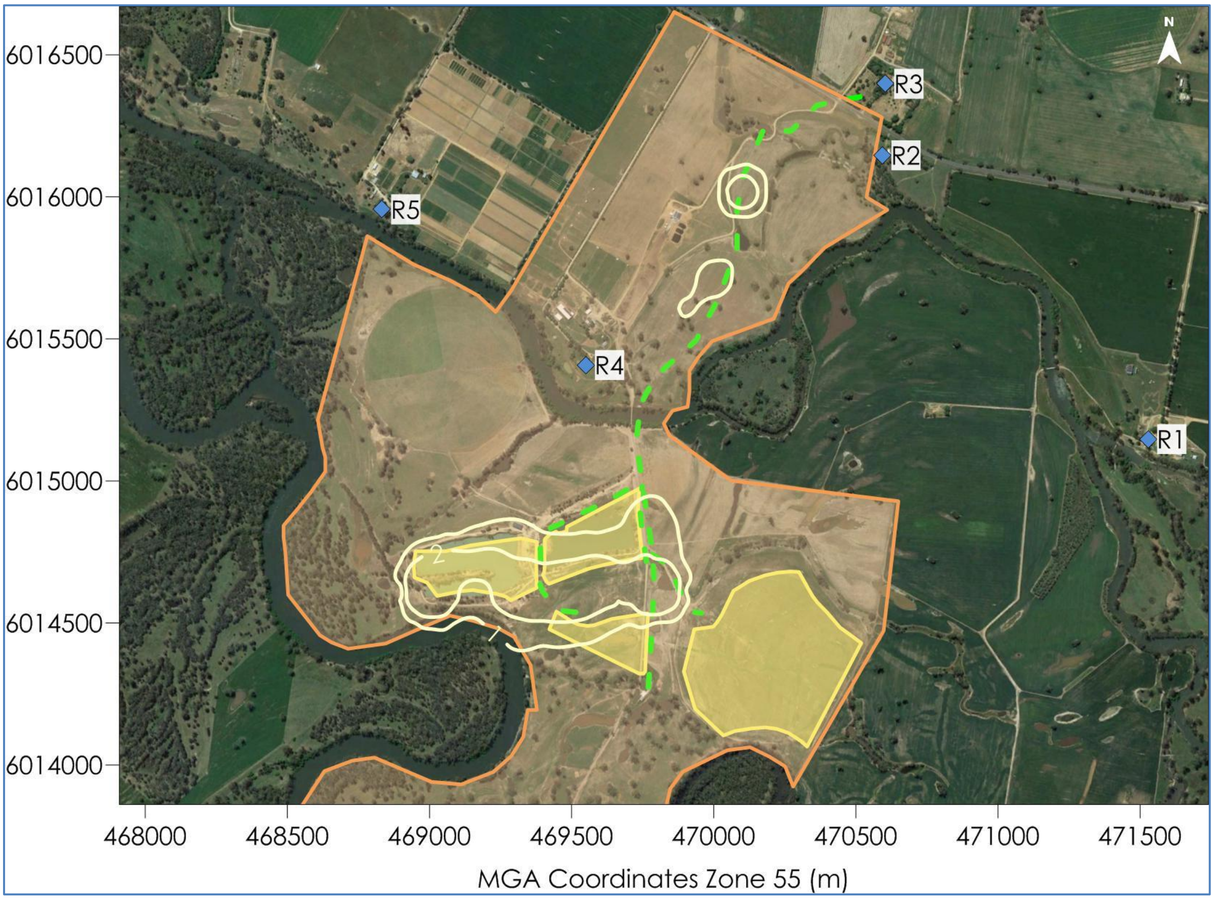

Figure C-2: Predicted incremental annual average $PM_{2.5}$ concentrations (µg/m³)

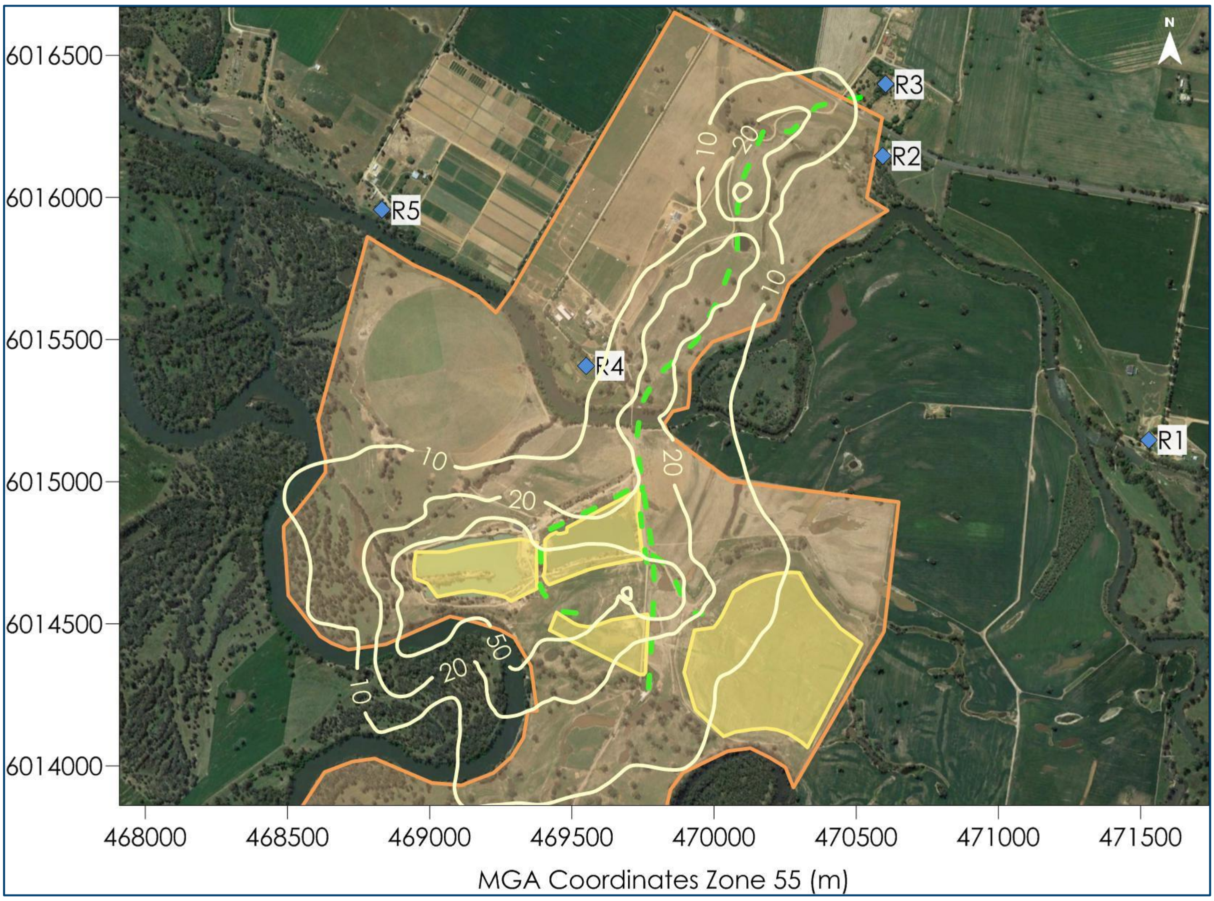

Figure C-3: Predicted incremental maximum 24-hour average PM_{10} concentrations (µg/m³)

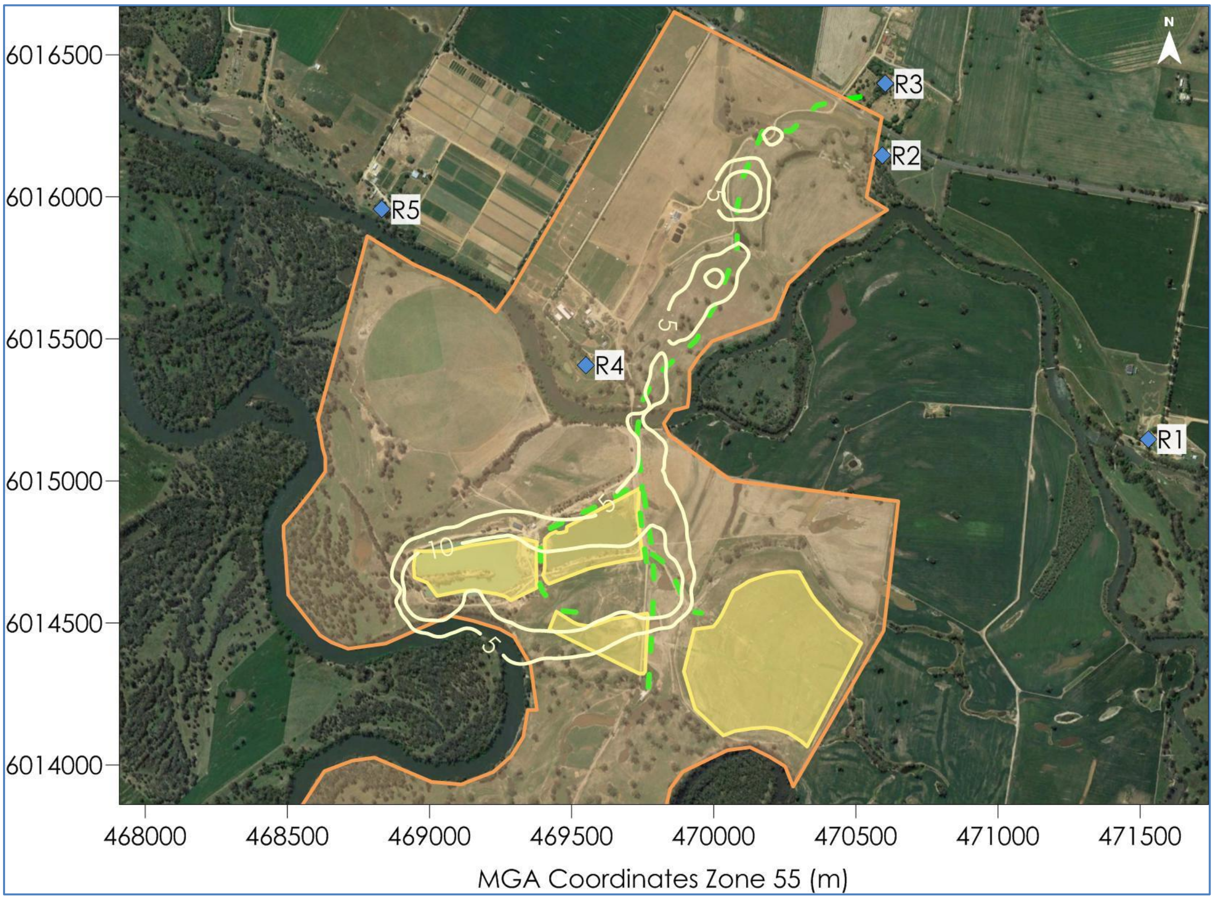

Figure C-4: Predicted incremental annual average PM_{10} concentrations (µg/m³)

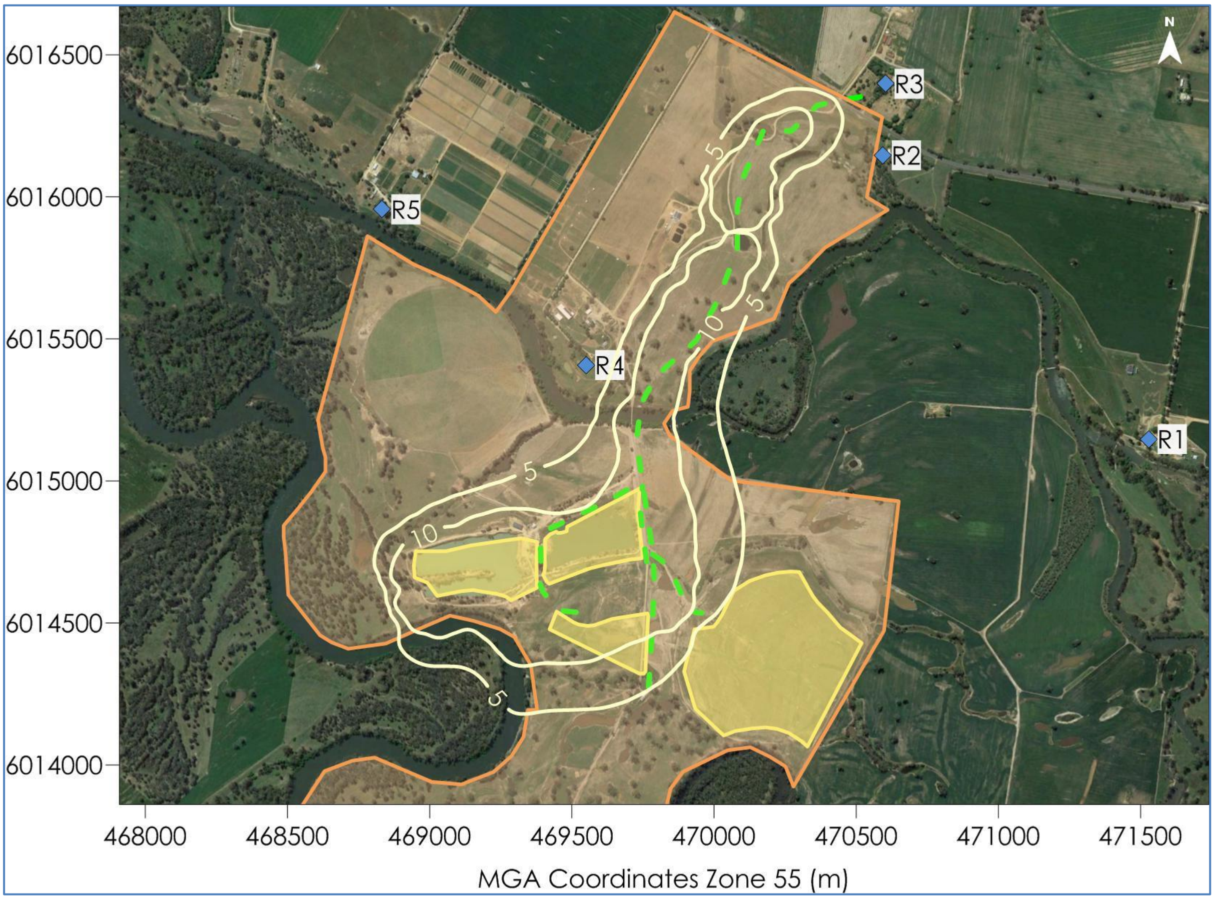

Figure C-5: Predicted incremental annual average TSP concentrations (µg/m³)

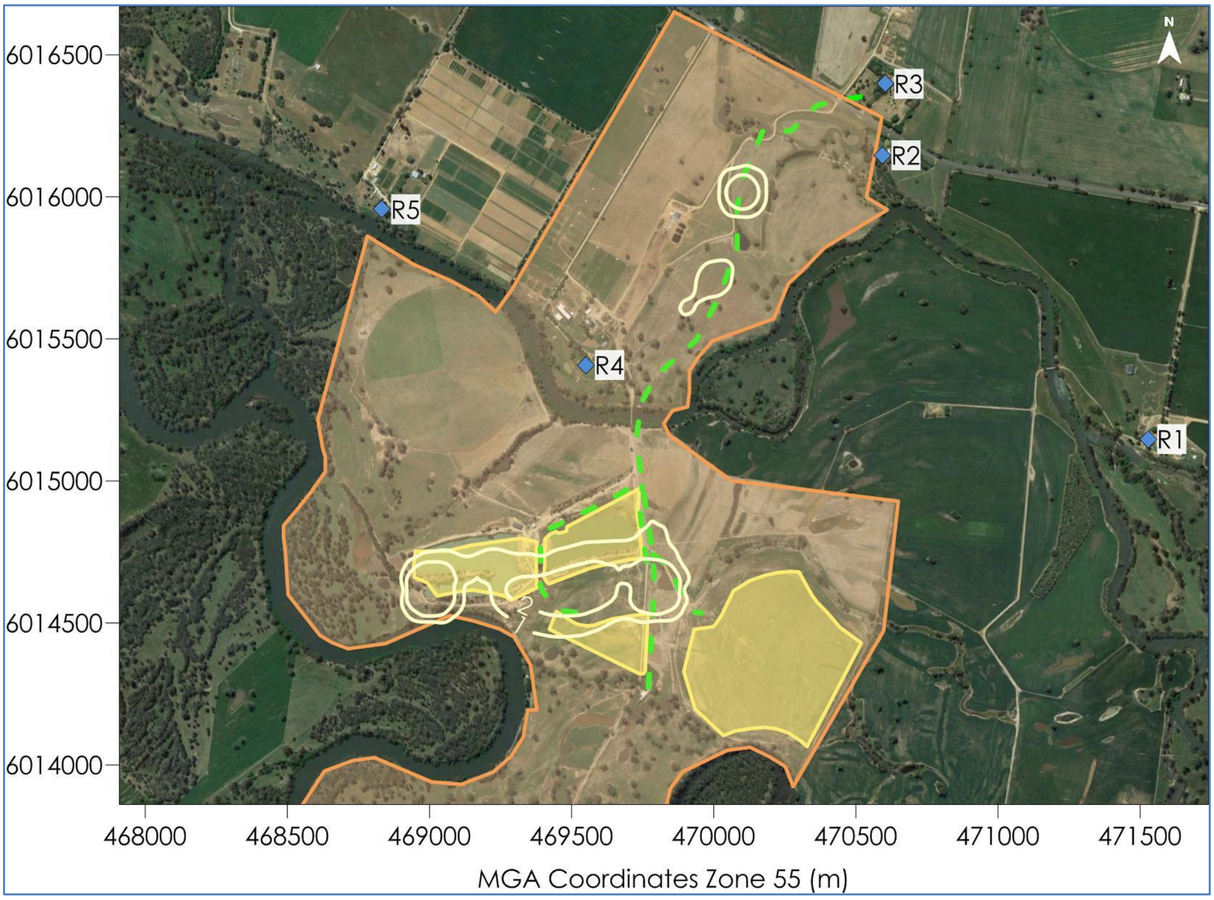

Figure C-6: Predicted incremental annual average dust deposition levels (g/m²/month)

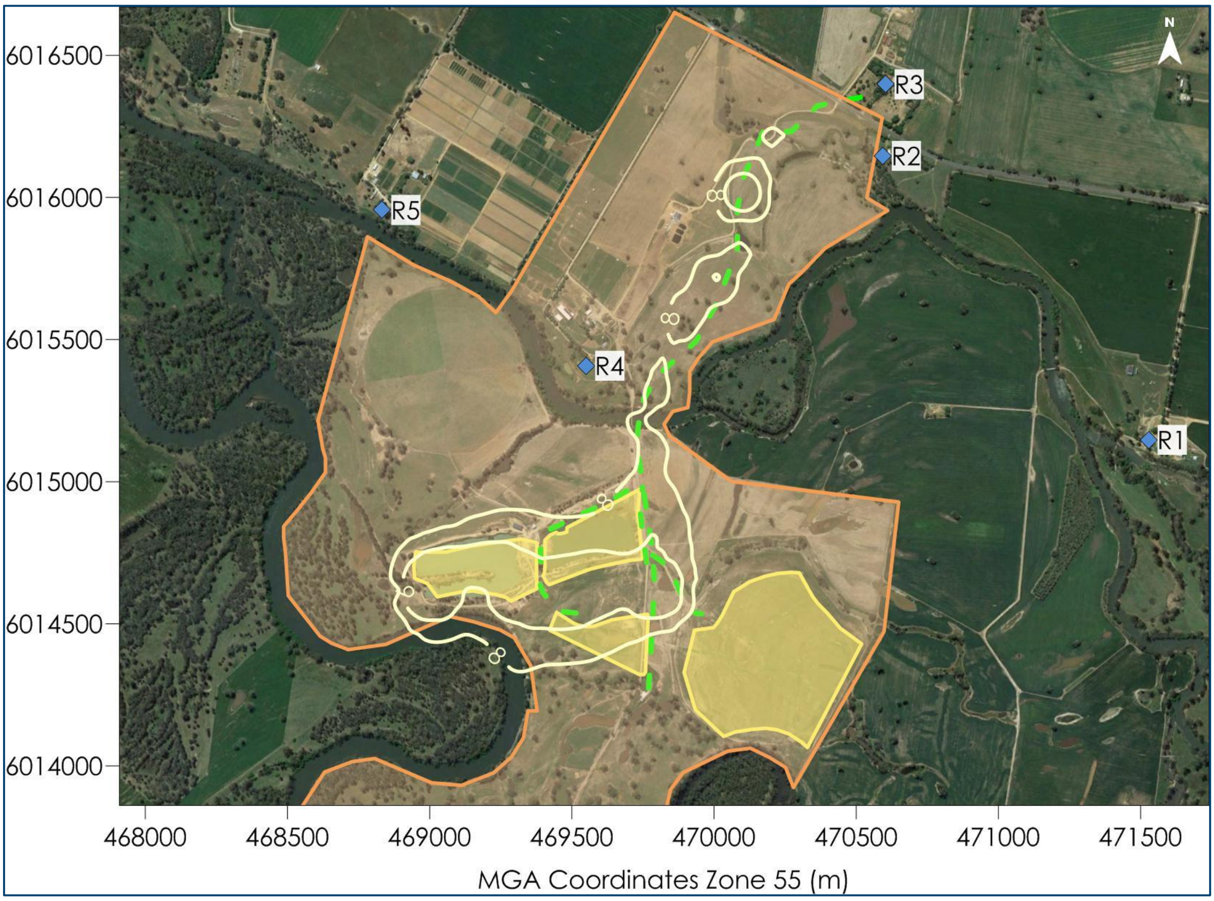

Figure C-7: Predicted cumulative annual average $PM_{2.5}$ concentrations (µg/m³)

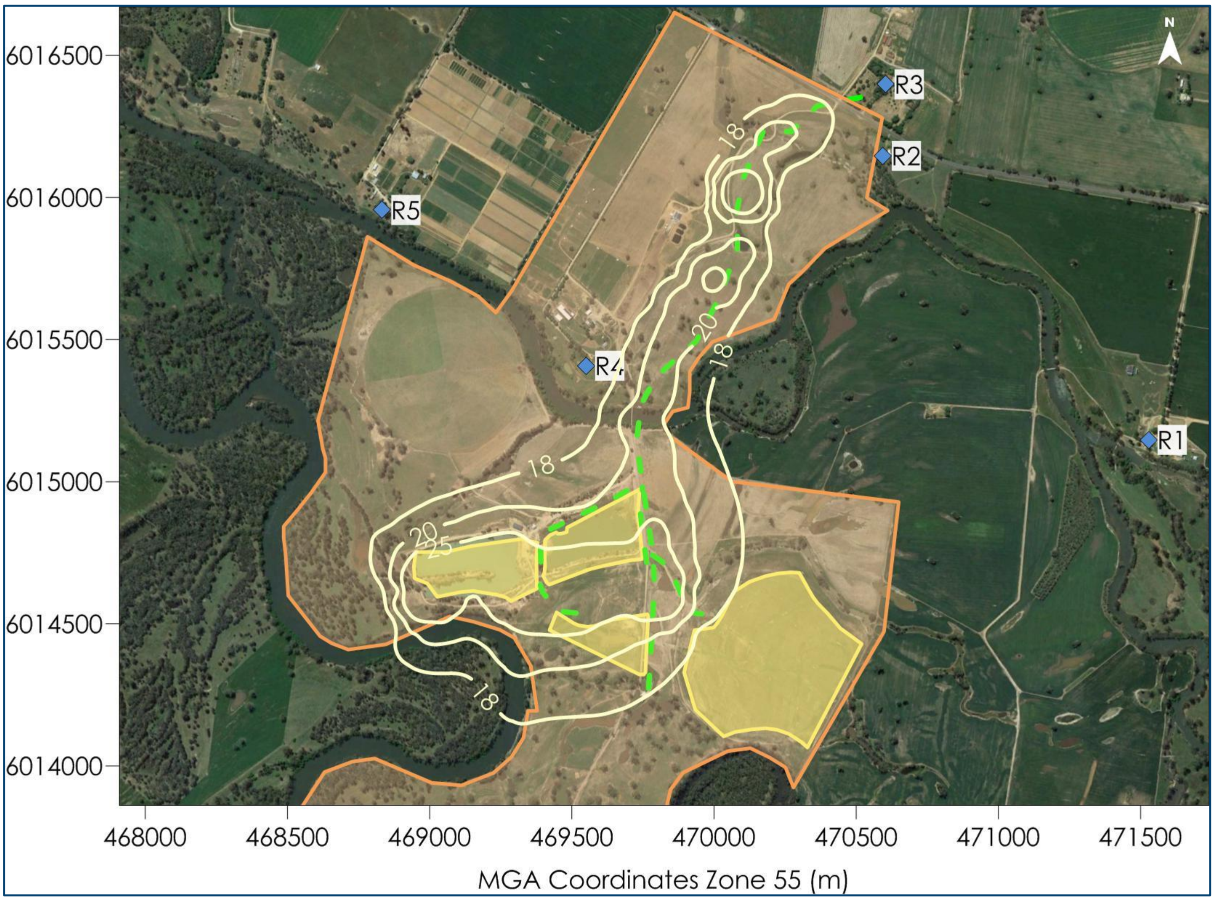

Figure C-8: Predicted cumulative annual average PM_{10} concentrations (µg/m³)

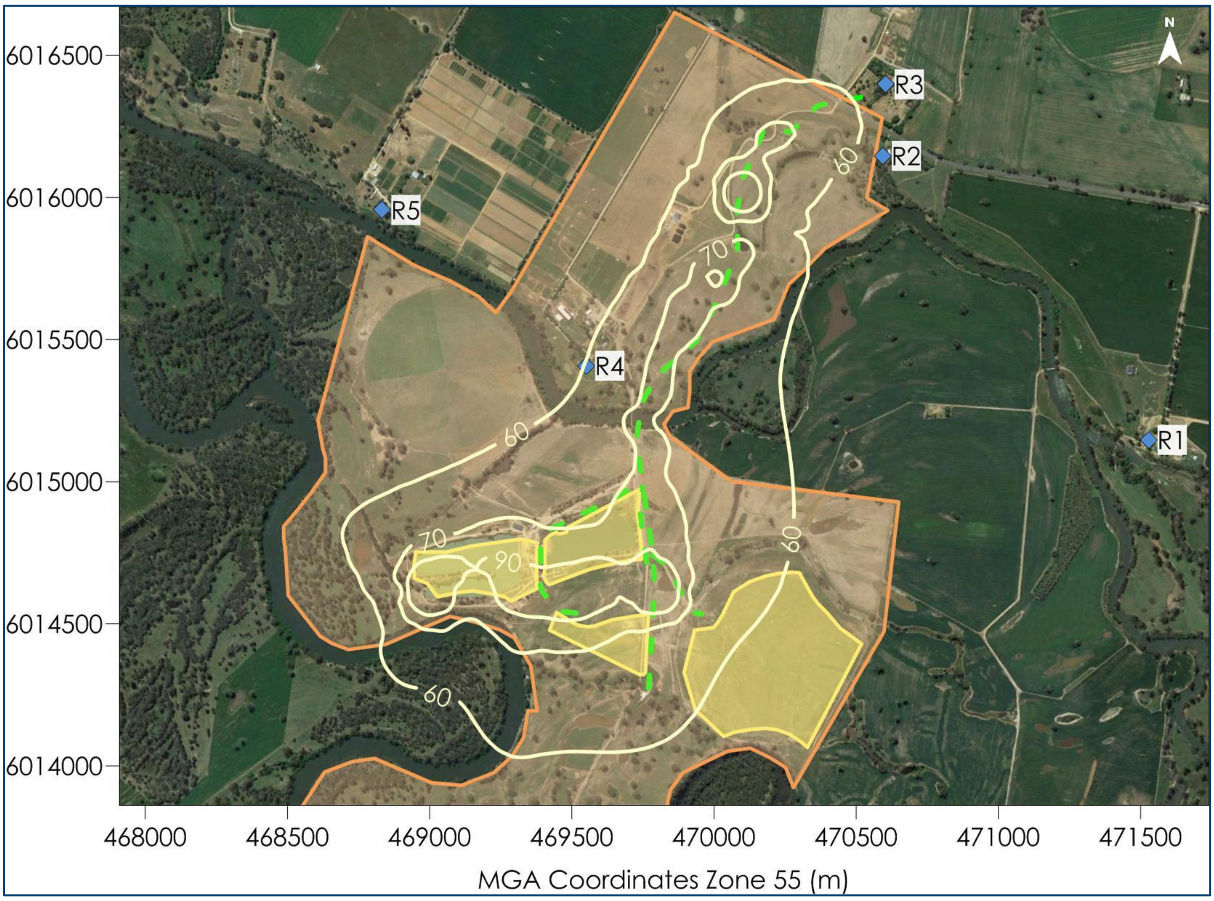

Figure C-9: Predicted cumulative annual average TSP concentrations (µg/m³)

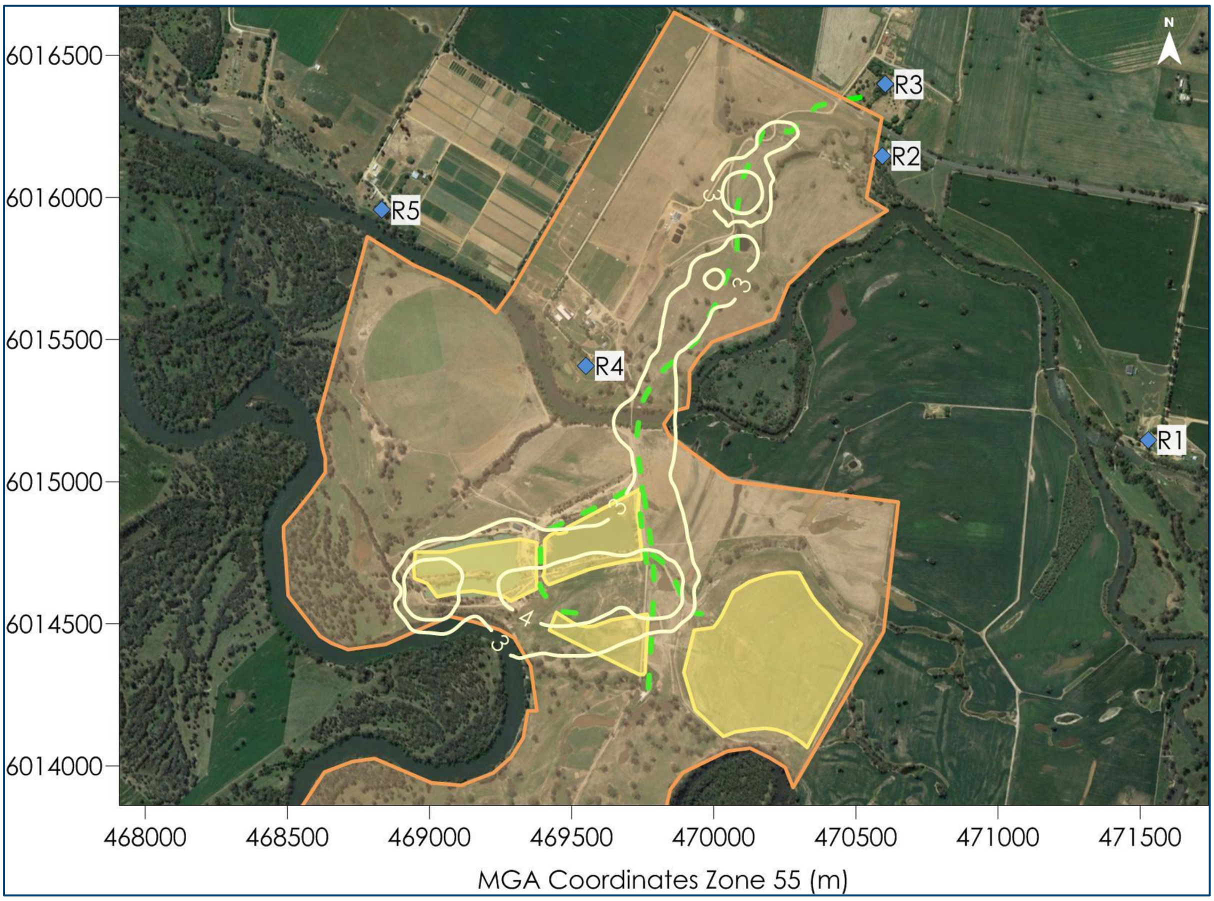

Figure C-10: Predicted cumulative annual average dust deposition levels (g/m²/month)

Appendix D

Further detail regarding 24-hour $PM_{2.5}$ and PM_{10} analysis

Further detail regarding 24-hour average $PM_{2.5}$ and PM_{10} analysis

The analysis below provides a cumulative 24-hour $PM_{2.5}$ and a 24-hour PM_{10} impact assessment in accordance with the NSW EPA Approved Methods; refer to the worked example on Page 46 to 47 of the Approved Methods.

The background level is the ambient level at the Wagga Wagga North monitoring station for $PM_{2.5}$ and at the Albury monitoring station for PM_{10}.

The predicted increment is the predicted level to occur at the receptor due to the project.

The total is the sum of the background level and the predicted level. The totals may have minor discrepancies due to rounding.

Each table assesses one receiver. The left half of the table examines the cumulative impact during the periods of highest background levels and the right half of the table examines the cumulative impact during the periods of highest contribution from the project.

The green shading represents days ranked per the highest background level but below the criteria.

The blue shading represents days ranked per the highest predicted increment level but below the criteria.

The orange shading represents days where the measured background level is already over the criteria.

Any value above the $PM_{2.5}$ criterion of 25µg/m^3 or above the PM_{10} criterion of 50µg/m^3 is in **bold red.**

Tables D-1 to **D-10** show the predicted maximum cumulative levels at each receptor surrounding the Quarry.

Table D-1: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R1

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
19/10/2013	29.9	0.0	29.9				
20/10/2013	28.4	0.0	28.4				
11/04/2013	26.3	0.0	26.3				
11/05/2013	24.2	0.0	24.2	3/06/2013	8.7	0.4	9.1
19/01/2013	22.3	0.0	22.3	26/05/2013	16.3	0.3	16.6
10/05/2013	21.7	0.0	21.7	8/06/2013	13.4	0.3	13.7
12/04/2013	20.8	0.0	20.8	20/06/2013	15.7	0.3	16.0
3/07/2013	20.6	0.0	20.6	30/06/2013	11.0	0.3	11.3
26/07/2013	20.2	0.0	20.2	7/06/2013	5.5	0.3	5.8
27/07/2013	19.6	0.0	19.6	26/09/2013	7.0	0.2	7.2
22/06/2013	18.8	0.0	18.8	25/10/2013	4.4	0.2	4.6
1/08/2013	18.6	0.0	18.6	11/09/2013	4.6	0.2	4.8
9/06/2013	17.1	0.0	17.1	18/05/2013	5.7	0.2	5.9

Table D-2: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R2

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
19/10/2013	29.9	0.0	29.9				
20/10/2013	28.4	0.0	28.4				
11/04/2013	26.3	0.0	26.3				
11/05/2013	24.2	0.0	24.2	8/06/2013	13.4	0.8	14.2
19/01/2013	22.3	0.1	22.4	24/05/2013	14.9	0.7	15.6
10/05/2013	21.7	0.0	21.7	26/05/2013	16.3	0.7	17.0
12/04/2013	20.8	0.0	20.8	24/07/2013	15.8	0.6	16.4
3/07/2013	20.6	0.0	20.6	8/07/2013	14.2	0.6	14.8
26/07/2013	20.2	0.1	20.3	17/06/2013	6.2	0.6	6.8
27/07/2013	19.6	0.0	19.6	16/06/2013	13.7	0.6	14.3
22/06/2013	18.8	0.0	18.8	20/06/2013	15.7	0.5	16.2
1/08/2013	18.6	0.1	18.7	7/06/2013	5.5	0.5	6.0
9/06/2013	17.1	0.0	17.1	10/04/2013	15.7	0.5	16.2

Table D-3: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R3

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
19/10/2013	29.9	0.0	29.9				
20/10/2013	28.4	0.0	28.4				
11/04/2013	26.3	0.1	26.4				
11/05/2013	24.2	0.0	24.2	17/06/2013	6.2	0.8	7.0
19/01/2013	22.3	0.2	22.5	24/05/2013	14.9	0.8	15.7
10/05/2013	21.7	0.0	21.7	16/06/2013	13.7	0.8	14.5
12/04/2013	20.8	0.0	20.8	8/06/2013	13.4	0.7	14.1
3/07/2013	20.6	0.0	20.6	2/06/2013	5.7	0.6	6.3
26/07/2013	20.2	0.0	20.2	24/07/2013	15.8	0.6	16.4
27/07/2013	19.6	0.0	19.6	10/04/2013	15.7	0.5	16.2
22/06/2013	18.8	0.0	18.8	17/04/2013	4.9	0.5	5.4
1/08/2013	18.6	0.0	18.6	29/06/2013	12.3	0.5	12.8
9/06/2013	17.1	0.0	17.1	8/07/2013	14.2	0.5	14.7

Table D-4: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R4

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
19/10/2013	29.9	0.1	30.0				
20/10/2013	28.4	0.0	28.4				
11/04/2013	26.3	0.4	26.7				
11/05/2013	24.2	0.2	24.4	28/06/2013	9.3	1.2	10.5
19/01/2013	22.3	0.3	22.6	21/06/2013	16.8	1.0	17.8
10/05/2013	21.7	0.5	22.2	26/06/2013	15.1	0.9	16.0
12/04/2013	20.8	0.1	20.9	19/06/2013	8.6	0.8	9.4
3/07/2013	20.6	0.0	20.6	12/06/2013	6.6	0.8	7.4
26/07/2013	20.2	0.0	20.2	10/07/2013	9.7	0.8	10.5
27/07/2013	19.6	0.3	19.9	22/05/2013	13.2	0.8	14.0
22/06/2013	18.8	0.3	19.1	25/06/2013	7.6	0.8	8.4
1/08/2013	18.6	0.0	18.6	11/06/2013	13.1	0.7	13.8
9/06/2013	17.1	0.6	17.7	29/11/2013	6.3	0.7	7.0

Table D-4: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R5

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
19/10/2013	29.9	0.0	29.9				
20/10/2013	28.4	0.0	28.4				
11/04/2013	26.3	0.1	26.4				
11/05/2013	24.2	0.0	24.2	28/06/2013	9.3	0.5	9.8
19/01/2013	22.3	0.1	22.4	26/06/2013	15.1	0.4	15.5
10/05/2013	21.7	0.0	21.7	22/05/2013	13.2	0.4	13.6
12/04/2013	20.8	0.0	20.8	25/06/2013	7.6	0.4	8.0
3/07/2013	20.6	0.0	20.6	12/06/2013	6.6	0.4	7.0
26/07/2013	20.2	0.0	20.2	27/05/2013	14.6	0.3	14.9
27/07/2013	19.6	0.0	19.6	24/06/2013	9.5	0.3	9.8
22/06/2013	18.8	0.2	19.0	10/07/2013	9.7	0.3	10.0
1/08/2013	18.6	0.0	18.6	9/07/2013	12.8	0.3	13.1
9/06/2013	17.1	0.0	17.1	21/06/2013	16.8	0.3	17.1

Table D-5: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R1

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured backgrou nd level	Predicted increment	Total cumulative 24-hr average level
4/04/2013	59.2	0.0	59.2				
22/03/2013	50.9	1.1	52.0				
3/04/2013	48.0	0.0	48.0	3/06/2013	12.3	2.6	14.9
11/05/2013	47.8	0.0	47.8	26/05/2013	14.0	2.1	16.1
12/04/2013	47.4	0.0	47.4	11/09/2013	12.8	2.0	14.8
8/01/2013	45.8	0.4	46.2	7/06/2013	8.7	1.9	10.6
19/01/2013	43.5	0.0	43.5	17/05/2013	9.5	1.8	11.3
13/04/2013	41.6	0.0	41.6	18/05/2013	9.6	1.8	11.4
5/04/2013	41.5	0.0	41.5	30/06/2013	14.6	1.8	16.4
14/04/2013	40.6	1.5	42.1	8/06/2013	13.2	1.8	15.0
6/04/2013	37.2	0.0	37.2	20/06/2013	11.0	1.8	12.8
8/11/2013	36.1	0.4	36.5	28/09/2013	17.8	1.8	19.6

Table D-6: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R2

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured backgrou nd level	Predicted increment	Total cumulative 24-hr average level
4/04/2013	59.2	0.0	59.2				
22/03/2013	50.9	2.4	53.3				
3/04/2013	48.0	0.0	48.0	8/06/2013	13.2	6.4	19.6
11/05/2013	47.8	0.0	47.8	24/05/2013	13.4	5.3	18.7
12/04/2013	47.4	0.1	47.5	26/05/2013	14.0	5.2	19.2
8/01/2013	45.8	0.6	46.4	24/07/2013	9.4	4.6	14.0
19/01/2013	43.5	1.0	44.5	7/06/2013	8.7	4.5	13.2
13/04/2013	41.6	0.0	41.6	10/04/2013	24.4	4.5	28.9
5/04/2013	41.5	0.0	41.5	8/07/2013	10.0	4.3	14.3
14/04/2013	40.6	3.8	44.4	7/10/2013	10.4	4.2	14.6
6/04/2013	37.2	0.0	37.2	16/06/2013	10.6	4.2	14.8
8/11/2013	36.1	0.3	36.4	20/06/2013	11.0	4.2	15.2

Table D-7: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R3

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
4/04/2013	59.2	0.0	59.2				
22/03/2013	50.9	0.1	51.0				
3/04/2013	48.0	0.0	48.0	16/06/2013	10.6	5.9	16.5
11/05/2013	47.8	0.0	47.8	24/05/2013	13.4	5.7	19.1
12/04/2013	47.4	0.0	47.4	17/06/2013	14.0	5.1	19.1
8/01/2013	45.8	0.3	46.1	8/06/2013	13.2	5.1	18.3
19/01/2013	43.5	1.3	44.8	2/06/2013	8.4	4.9	13.3
13/04/2013	41.6	0.0	41.6	10/04/2013	24.4	4.7	29.1
5/04/2013	41.5	0.0	41.5	17/04/2013	16.7	4.6	21.3
14/04/2013	40.6	1.3	41.9	24/07/2013	9.4	4.2	13.6
6/04/2013	37.2	0.0	37.2	15/06/2013	11.1	4.0	15.1
8/11/2013	36.1	0.2	36.3	29/06/2013	14.5	4.0	18.5

Table D-8: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R4

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
4/04/2013	59.2	2.5	61.7				
22/03/2013	50.9	0.0	50.9				
3/04/2013	48.0	2.0	50.0	28/06/2013	14.5	8.5	23.0
11/05/2013	47.8	1.6	49.4	21/06/2013	12.7	6.7	19.4
12/04/2013	47.4	1.0	48.4	12/06/2013	6.0	6.3	12.3
8/01/2013	45.8	0.2	46.0	26/06/2013	10.4	6.1	16.5
19/01/2013	43.5	2.2	45.7	19/06/2013	12.0	5.8	17.8
13/04/2013	41.6	0.0	41.6	10/07/2013	11.2	5.7	16.9
5/04/2013	41.5	3.2	44.7	22/05/2013	14.2	5.6	19.8
14/04/2013	40.6	0.1	40.7	11/06/2013	11.6	5.6	17.2
6/04/2013	37.2	3.4	40.6	25/06/2013	8.8	5.4	14.2
8/11/2013	36.1	0.0	36.1	17/03/2013	9.3	5.2	14.5

Table D-7: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R5

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
4/04/2013	59.2	1.0	60.2				
22/03/2013	50.9	0.0	50.9				
3/04/2013	48.0	1.4	49.4	28/06/2013	14.5	3.1	17.6
11/05/2013	47.8	0.0	47.8	26/06/2013	10.4	3.0	13.4
12/04/2013	47.4	0.0	47.4	22/05/2013	14.2	2.8	17.0
8/01/2013	45.8	0.0	45.8	12/06/2013	6.0	2.8	8.8
19/01/2013	43.5	0.5	44.0	25/06/2013	8.8	2.6	11.4
13/04/2013	41.6	0.0	41.6	27/05/2013	11.7	2.3	14.0
5/04/2013	41.5	0.7	42.2	10/07/2013	11.2	2.3	13.5
14/04/2013	40.6	0.0	40.6	24/06/2013	9.9	2.1	12.0
6/04/2013	37.2	0.7	37.9	21/06/2013	12.7	2.0	14.7
8/11/2013	36.1	0.0	36.1	9/07/2013	10.3	2.0	12.3

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